

SOUTH CAROLINA Hurricane Evacuation Study



Appendix II Behavioral Analyses

December 1986

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Prepared for
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in cooperation with
The U.S. Army Engineer District, Charleston, S.C.

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TABLE OF CONTENTS
APPENDIX II
BEHAVIORAL ANALYSES

	<u>Page</u>
TITLE PAGE	i
TABLE OF CONTENTS	ii
LIST OF TABLES	iv
LIST OF FIGURES	v
 <u>GRAND STRAND REGION</u>	
 METHODS	
Mix of Methods	GS1-1
Sample Sizes	GS1-2
Behaviors Addressed	GS1-3
 RESIDENTS	
Surveys Following Diana	GS2-1
Hypothetical Responses	GS2-8
Hypothetical Response Studies in Other Areas	GS2-8
Actual Responses in Other Areas	GS2-16
Conclusions	GS2-17
 VACATIONERS	
Interview Results	GS2-19
Results from Other Locations	GS2-23
Conclusions	GS2-23
 VACATION TIMING	
	GS3-1
 RESIDENTS	
Surveys Following Diana	GS3-1
Hypothetical Responses	GS3-1
Hypothetical Responses in Other Locations	GS3-1
Actual Response Curves in Other Areas	GS3-1
Conclusions	GS3-6
 VACATIONERS	
Conclusions	GS3-7
	GS3-7
 TYPE OF REFUGE	
	GS4-1
 RESIDENTS	
Surveys Following Diana	GS4-1
Nonevacuees' Hypothetical Response	GS4-1
Pre-Diana Hypothetical Surveys	GS4-1
Hypothetical Responses in Other Locations	GS4-6
Actual Response Studies	GS4-6
Conclusions	GS4-7
 VACATIONERS	
Conclusions	GS4-8
	GS4-10

TABLE OF CONTENTS (Continued)
APPENDIX II, BEHAVIORAL ANALYSES

<u>GRAND STRAND REGION (Continued)</u>	<u>Page</u>
DESTINATIONS AND ROUTES	GS5-1
RESIDENTS	
Surveys Following Diana	GS5-1
Pre-Diana Hypothetical Responses	GS5-1
Actual Responses in Other Locations	GS5-1
Conclusions	GS5-4
VACATIONERS	GS5-4
VEHICLE USE	GS6-1
RESIDENTS	
Surveys Following Diana	GS6-1
Pre-Diana Hypothetical Responses	GS6-1
Hypothetical Responses from Other Areas	GS6-1
Conclusions	GS6-1
VACATIONERS	GS6-6
APPENDICES	
Grand Strand Hypothetical Destinations	GSA-1
Georgetown Hypothetical Destinations	GSA-2
Grand Strand Destinations in Diana	GSA-3
Hurricane Diana Public Response Questionnaire	GSA-4
South Carolina Resident Questionnaire	GSA-11
Vacationer Questionnaire	GSA-15
South Carolina Campground Questions	GSA-20
Hotel/Motel Questions Regarding Hurricane Diana	GSA-22
<u>LOWER COAST REGION</u>	
MODEL OF PAST EXPERIENCE	LC1-1
HYPOTHETICAL THREAT RESPONSES	LC1-1
EVACUATION RATES	
Residents	LC2-1
Vacationers	LC2-1
Conclusions	LC2-1
EVACUATION TIMING	
Residents	LC3-1
Vacationers	LC3-1
Conclusions	LC3-1
TYPE OF REFUGE	
Residents	LC4-1
Vacationers	LC4-3
Conclusions	LC4-3

TABLE OF CONTENTS (Continued)
APPENDIX II, BEHAVIORAL ANALYSES

<u>LOWER COAST REGION (Continued)</u>	<u>Page</u>
LOCATION OF REFUGES	
Residents	LC5-1
Vacationers	LC5-1
Conclusions	LC5-1
VEHICLE USE	
Residents	LC6-1
Vacationers	LC6-1
Conclusions	LC6-1
APPENDIX ONE	
South Carolina Resident Questionnaire	LCA-2

LIST OF TABLES

	<u>Page</u>
<u>GRAND STRAND REGION</u>	
Table 1 States of Residence of Vacationers	GS2-19

LIST OF FIGURES

		<u>Page</u>
 <u>GRAND STRAND REGION</u>		
Figure 1	Warning Response in Diana	GS2-2
Figure 2	Residents Heard Official Evac Advice in Diana	GS2-3
Figure 3	Heard Evacuation Advice vs Order in Diana	GS2-4
Figure 4	Heard Evacuation Advice from NonOfficial Sources in Diana	GS2-5
Figure 5A	Reasons for Leaving in Diana Part A	GS2-6
Figure 5B	Reasons for Leaving in Diana Part B	GS2-7
Figure 6A	Reasons for Staying in Diana Part A	GS2-9
Figure 6B	Reasons for Staying in Diana Part B	GS2-10
Figure 6C	Reasons for Staying in Diana Part C	GS2-11
Figure 7	Heard Probabilities	GS2-12
Figure 8	Understood NWS Probabilities in Diana	GS2-13
Figure 9	Believed NWS Probabilities Useful in Diana	GS2-14
Figure 10	Hypothetical Early Evacuation Response	GS2-15
Figure 11	Vacationer's Prior Thought About Hurricane Evacuation	GS2-20
Figure 12	Vacationer's Belief Lodging Would Be Safe in Hurricane	GS2-21
Figure 13	Vacationer's Hypothetical Early Response in Good Weather	GS2-22
Figure 14	Effect of Bad Weather Rather Than Good on Vacationers' Plan to Leave Early	GS2-24
Figure 15	Hypothetical Response to Warning and Advice by Vacationers Remaining	GS2-25
Figure 16	Myrtle Beach Area Cumulative Evacuation in Diana	GS3-2
Figure 17	NC Southern Beach Cumulative Evacuation - Diana	GS3-3
Figure 18	Southern Mainland Cumulative Evacuation - Diana	GS3-4
Figure 19	Type of Refuge Used in Diana	GS4-2
Figure 20	When Diana Evacuees First Returned Home	GS4-3
Figure 21	Diana Stayers' Hypothetical Refuge	GS4-4
Figure 22	Hypothetical Refuges	GS4-5
Figure 23	Vacationer's Hypothetical Evacuation Refuges	GS4-9
Figure 24	Location of Refuge in Diana	GS5-2
Figure 25	Hypothetical State Destinations	GS5-3
Figure 26	No. of Vehicles Used in Diana	GS6-2
Figure 27	Available Vehicles in Diana Warning Area	GS6-3
Figure 28	Vehicles to be Used in Hypothetical Responses of Residents	GS6-4
Figure 29	Vehicles Available to Hypotheticals	GS6-5
 <u>LOWER COAST REGION</u>		
Figure 1	Hurricane Evacuation Behavior Model	LC1-2
Figure 2	Perceived Elevation	LC2-2
Figure 3	Stayers - Hypothetical and Past	LC2-3
Figure 4	Evacuation Before Notice - Hypothetical and Past	LC3-2
Figure 5	Refuges - Hypothetical and Past	LC4-2
Figure 6	Out-Of-Town Destinations - Hypothetical and Past	LC5-2
Figure 7	Source of Transportation	LC6-2

BEHAVIORAL ANALYSIS

GRAND STRAND REGION METHODS

Mix of Methods

Experience has shown that reliable forecasts of people's responses to hurricane threats cannot be made solely or even primarily from their answers to questions about hypothetical hurricane threats. We do believe, however, that place-specific survey results regarding people's intentions to respond to various threats can be combined with a careful analysis of what people have actually been observed to do in a wide variety of real hurricane threats to provide very reliable forecasts of the sorts of behaviors about which evacuation planners must make assumptions. We therefore employ a mix of information in arriving at our recommendations regarding the behavioral assumptions which should be made in hurricane evacuation studies in South Carolina's Grand Strand area:

1. Post-Diana surveys with 100 residents of what we refer to as the Myrtle Beach area -- actually the coastal area from North Myrtle Beach through Pawley's Island -- to ascertain what they did in response to the Diana threat. Another 100 interviews were conducted with residents of Georgetown with respect to the same subject. All interviews were done over the phone.
2. Interviews with 100 residents of both the Myrtle Beach and Georgetown areas before the Diana threat, asking respondents what they thought they would do during a hurricane threat. About 80% of these 200 people were contacted again in the post-Diana survey referred to above. These pre-, post- interviews were a valuable tool in judging the amount of confidence to place in responses to hypothetical survey questions.
3. Interviews with 150 vacationers in the Myrtle Beach area to elicit their intended responses to a hypothetical hurricane threat. These were conducted at three different times during the summer of 1984, half by telephone in the respondent's lodging and half face-to-face in various locations near the beaches.
4. Comparable interviews of all three of the above types in North Carolina:
 - a. 100 interviews in the beach areas of southern North Carolina to document residents' responses to Diana.
 - b. 100 interviews in mainland areas of coastal southern North Carolina, also to document residents' responses in Diana.
 - c. 100 interviews in the beach areas of northern North Carolina with respect to how residents expected to respond to hurricane threats.
 - d. 100 interviews with residents of northern mainland communities with respect to their hypothetical hurricane responses.
 - e. 200 interviews with vacationers in North Carolina beach areas, half in the north and half in the south.

5. Hypothetical responses from other locations. Several thousand interviews comparable to those conducted as part of this study have been conducted as parts of hurricane evacuation studies in other areas. We have reviewed most of those studies of which we are aware and included generalizations about their findings for comparison.

6. Actual response studies from other areas. Useful as the post-Diana interviews were to us, the Diana threat was only one of many possible hurricane threat scenarios, and public response will vary as the specifics of the threat vary. HMG directors have conducted most of the work ever undertaken to document what people actually do under what circumstances in real hurricane threats and evacuations. Using our own post-hurricane interview studies and the results of studies conducted by others, we have detected certain patterns of response which provide the backbone of our behavioral forecasts.

7. Campground operators in the Myrtle Beach area were phoned and asked about the responses of campers during the Diana threat. Interviews were completed with operators of seven of the largest campgrounds in the area. Questionnaires asking similar questions were mailed by the Myrtle Beach Hotel/Motel Association to all 400 of its members, but only 20 were returned.

Sample Sizes

In practical terms, the samples of 100 employed in most of the surveys in South Carolina yield population value estimates which one can be 90% "sure" are within 5 to 8 percentage points of the figures which would have been obtained if interviews had been conducted with everyone in the population from which the samples were taken. For example, when we say that 80% of the Myrtle Beach sample evacuated in Diana, we can be 90% "sure" that 80% + or - 8% (i.e., 72% to 88%) of all Myrtle Beach residents evacuated.

Larger samples would have provided slightly greater precision. Samples of 500 would have given estimates accurate within 4 percentage points, for example (i.e., 80% + or - 4% or 76% to 84%). For our purposes such additional precision would have been wasteful of the resources necessary to attain it. Hypothetical response data and single-event (i.e., Diana) response data are of very limited value for predicting what people will actually do in a wide variety of hurricane threats. There was no point, therefore, in attaining extremely precise estimates which have such limited usefulness. The precision provided by our samples was sufficient for the comparative uses to which it was put.

The usefulness of the campground and motel operator samples is less clear. If the operators' perceptions or recalls of how their guests responded to the threat are inaccurate, then their responses are useless regardless of the sample sizes. Most of the motels have sixty or fewer rooms, and many of the operators are well acquainted with their guests. Some of the questions (When did your guests leave? How many returned? etc.) should yield more reliable responses than others (How many went to public shelters. etc.).

The 20 motel operator interviews are certainly a small number, but the establishments account for 704 rooms altogether. If the operators' responses were accurate and those 20 motels were representative of most others in the Grand Strand, the data could be extremely useful. The problem is knowing how representative they are of the others, a problem made worse by the very low response rate. The campgrounds, however, account for roughly 75% of the campsites in the area, so if their operators' perceptions are accurate, they should provide a very good indication of how campers responded to Diana. Although vacationer response to Diana is of limited usefulness because of the uniqueness of the Diana threat, we would tend to rely more upon it than we would like simply because of the absence of other data documenting actual vacationer responses in other storms.

Behaviors Addressed

We address five distinct types of public response:

- Evacuation Rates. (whether people will evacuate)
- Evacuation Timing. (when people will leave)
- Refuge Use. (what types of shelter people will use)
- Evacuation Destinations. (out-of-town vs. local)
- Number of Vehicles to Be Used.

Each of the behaviors is addressed separately for residents and vacationers. We include recommendations for specific quantitative values planners can use, but we also include guidelines for modifying the assumptions to better suit a wide variety of threat scenarios.

EVACUATION RATES

Residents

Surveys Following Diana

During the Diana threat, about 48% of the Myrtle Beach area residents evacuated, while less than 10% of Georgetown left (Fig. 1). The Myrtle Beach response was similar to that of mainland residents and below that of beach residents of southern North Carolina, and Georgetown's was closer to that observed in the northern North Carolina coastal area. Although sample sizes in the surveys aren't large enough to permit estimates for specific towns and communities, there is reason to believe that in North Carolina some of the beach communities had near-total evacuation. A separate survey conducted in Wrightsville Beach indicated that over 99% might have left there.

The reported evacuation rates in both the Myrtle Beach and Georgetown areas were consistent with notices issued by public officials and with National Weather Service local statements, both of which were based upon emergency managers' assessment of the threat posed by Diana to various locations in the area. The "low" evacuation rates do not necessarily indicate inappropriate behavior either by the public or by emergency management officials.

Figure 2 reveals one of the principal reasons that relatively few evacuated even in Myrtle Beach. About 57% said no one in an official capacity told them to. In Georgetown, over 90% said they didn't hear that they should leave. In fact the public evacuation advisory in the Myrtle Beach area specified only that people living or staying immediately adjacent to the water should leave. Thus, more residents thought the notice applied to them than was apparently intended. In our sample 60% of the residents living east of Highway 17 evacuated, compared to 40% west (inland) of the highway. Traditional criteria for statistical tests would not indicate that the two evacuation figures are necessarily different in the larger populations from which the samples were drawn, but it is important to note that so many left from west of the highway.

Figure 2 also depicts the sources of what residents perceived as evacuation advice from officials. Police and firefighters were the most commonly cited sources. Of those residents who said they heard from officials that they should leave, the great majority understood the notice to be advisory rather than an order (Figure 3).

In the Myrtle Beach area about half the sample heard from some nonofficial source that they should leave, but in Georgetown only about 17% did (Figure 4). The most commonly reported nonofficial sources were friends and the media.

Respondents who said they evacuated were asked to list the main things which made them decide to leave. Reasons dealing with advice from various sources are shown in Figure 5A, and reasons dealing with beliefs about the storm or specific types of information are depicted in Figure 5B. In Myrtle Beach about 35% of the evacuees said the media convinced them to go, with other information sources being mentioned less frequently. However, respondents who heard official notices through the media might be included

Figure 1

WARNING RESPONSE IN DIANA (%)

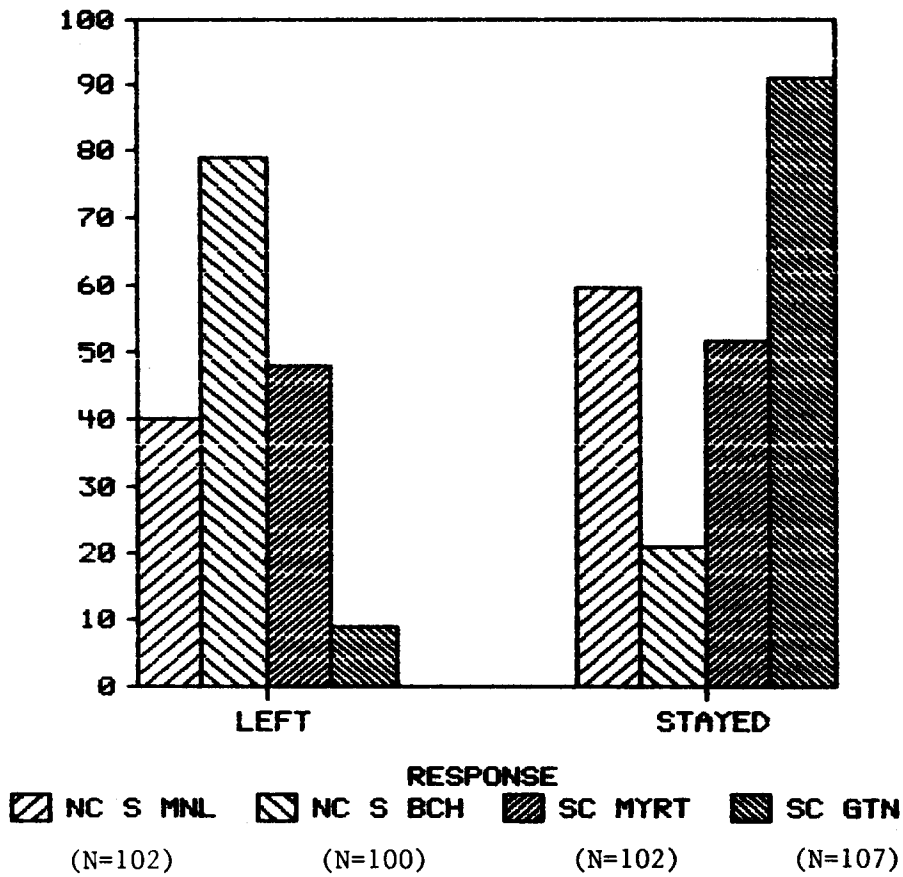


Figure 2

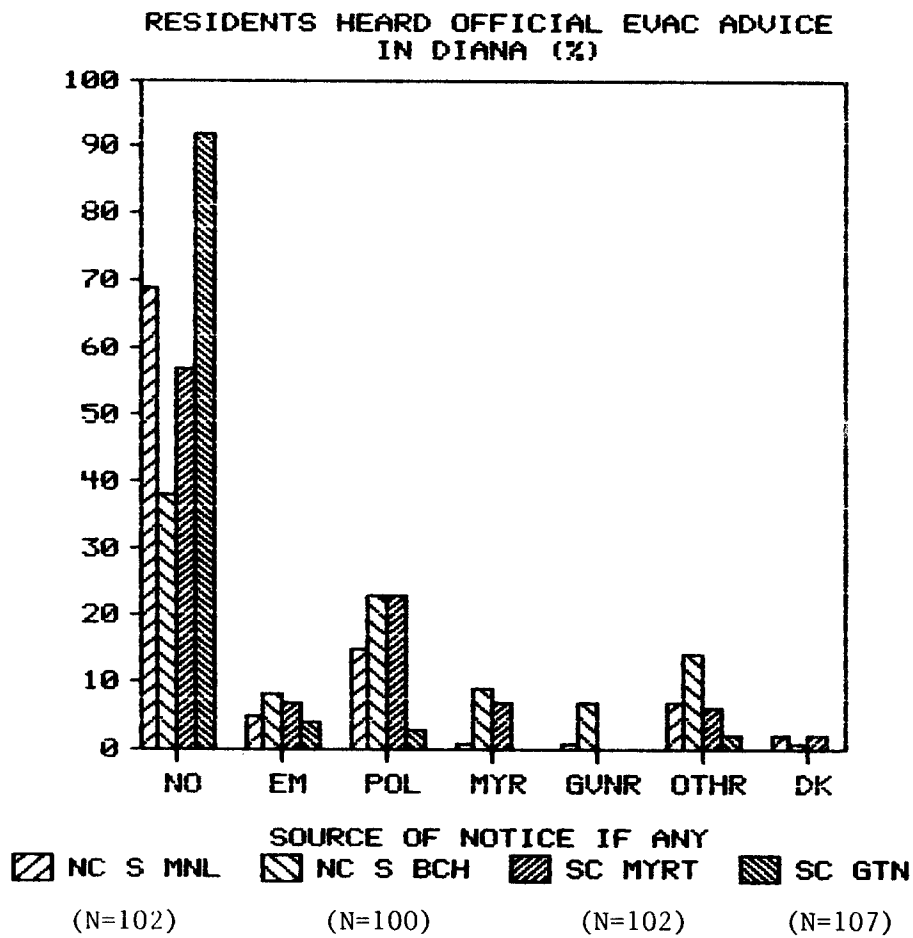


Figure 3

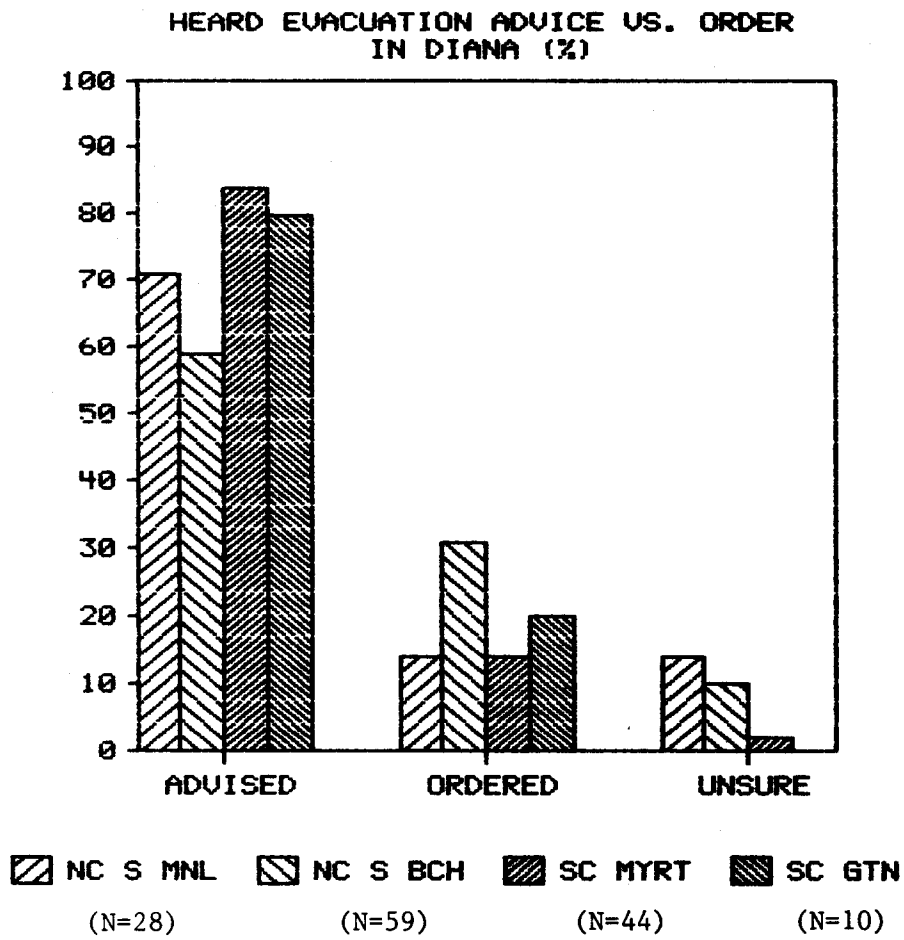


Figure 4

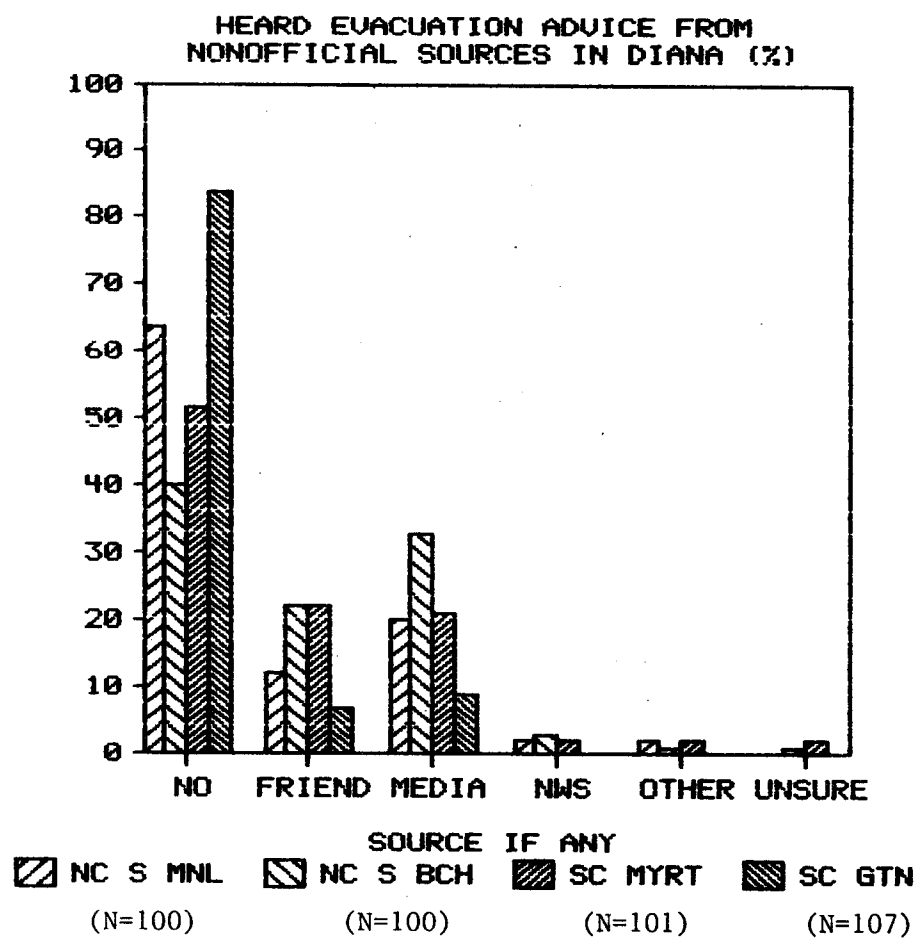


Figure 5A

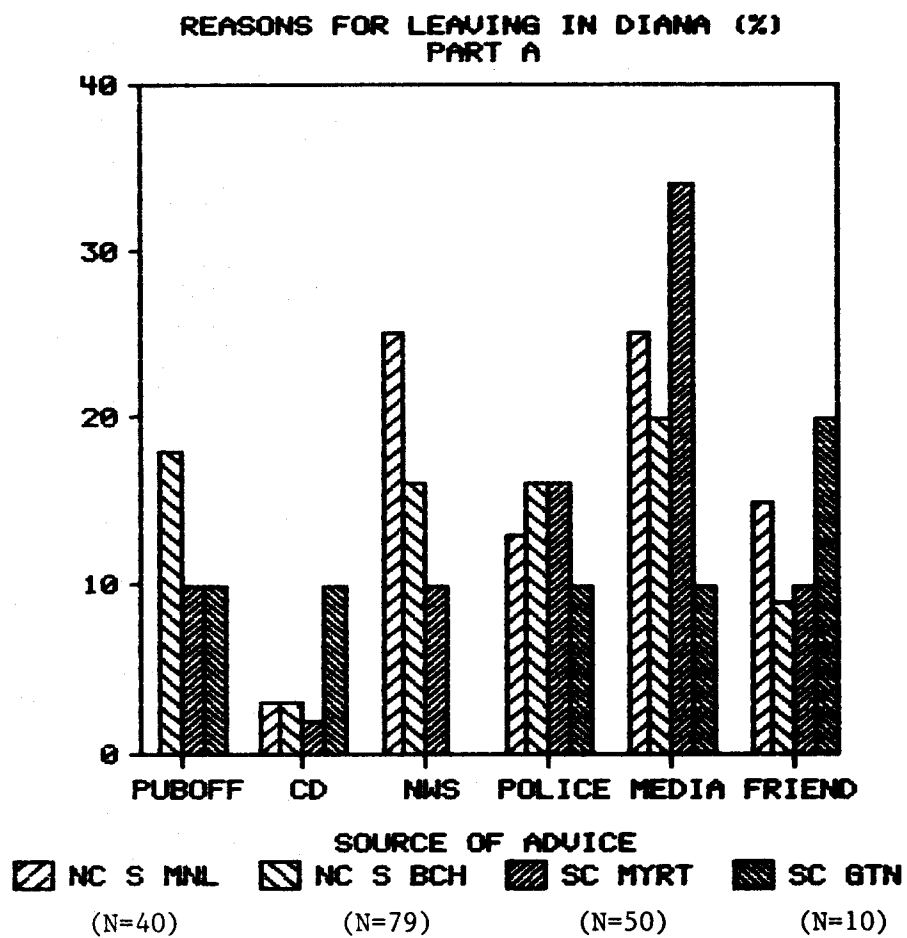
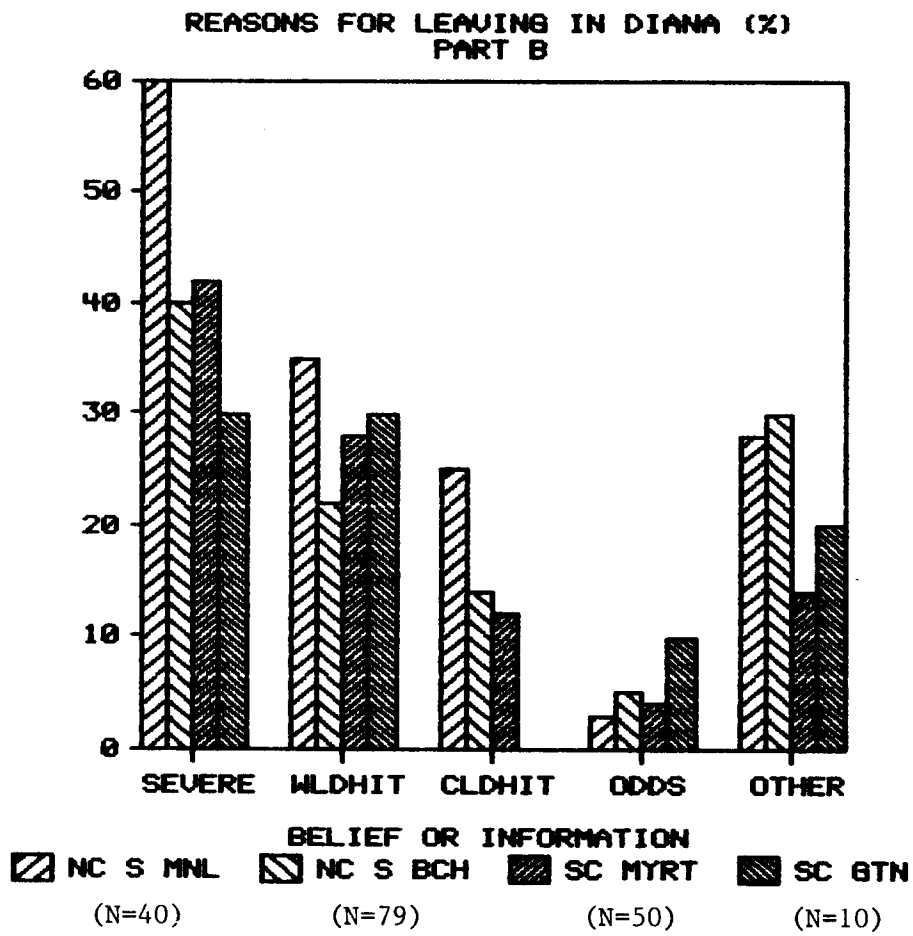


Figure 5B



in this response category. Between 30% and 40% of those who left said they did so either because of what they believed to be the severity of the storm or simply the belief that it would hit their area. (NOTE: Due to the small number of Georgetown evacuees in our sample, their behaviors should not be inferred to all Georgetown evacuees.)

People who didn't evacuate were also asked their reasons, and the results appear in Figures 6A, 6B, and 6C. The great majority of stayers said they felt safe staying where they were (6A), while a few mentioned low NWS probabilities or that the track was not in their direction (6B).

Speaking of NWS probabilities, almost 70% of the Myrtle Beach respondents and a little under 50% of the Georgetown sample said they remembered hearing the numbers (Figure 7). Of those who heard them, 70% to 80% believed they understood them at least somewhat, and almost everyone thought they were useful (Figures 8, 9).

About 70% of the Myrtle Beach respondents and 74% of the Georgetown sample said they had experienced at least one hurricane threat before Diana. David and Hazel were mentioned most frequently. More than half the Myrtle Beach residents said they had evacuated at least once in past threats, compared to only 20% in Georgetown.

Hypothetical Responses

In interviews conducted in the Myrtle Beach area and in Georgetown before Diana, two hypothetical hurricane threats were presented to respondents, and they were asked how they would respond to the threats. The first threat involved a weak storm for which there was a watch in effect and no advice by local officials that people should evacuate. Given those conditions about 35% in both Myrtle Beach and Georgetown said they would leave (Figure 10). The responses were roughly the same on both sides of Highway 17 in the Myrtle Beach area. An interesting finding in the northern coastal area of North Carolina was that in that region, given the early threat just described above, more mainland than beach residents said they would evacuate. When a more severe threat was described (a worse storm, with a warning in effect, for which local officials were advising evacuation), only 3% or 4% insisted that they wouldn't leave. In mainland areas of northern North Carolina 8% said they wouldn't leave, as did 14% of the beach residents in that area.

Hypothetical Response Studies in Other Areas

The only data on people's expressed intentions to evacuate in the sort of "low risk" threat with which Carolina residents were first presented (watch, no advice or order) was collected in the north Florida, Alabama, and Mississippi areas. In those locations about 60% to 70% of the respondents said they would leave, somewhat higher than the rates found in South Carolina surveys.

Most surveys undertaken throughout all of Florida, Alabama, and Mississippi have found about 5% to 7% of the coastal respondents saying they wouldn't leave even if ordered to do so by public officials. The responses in South Carolina were comparable.

Figure 6A

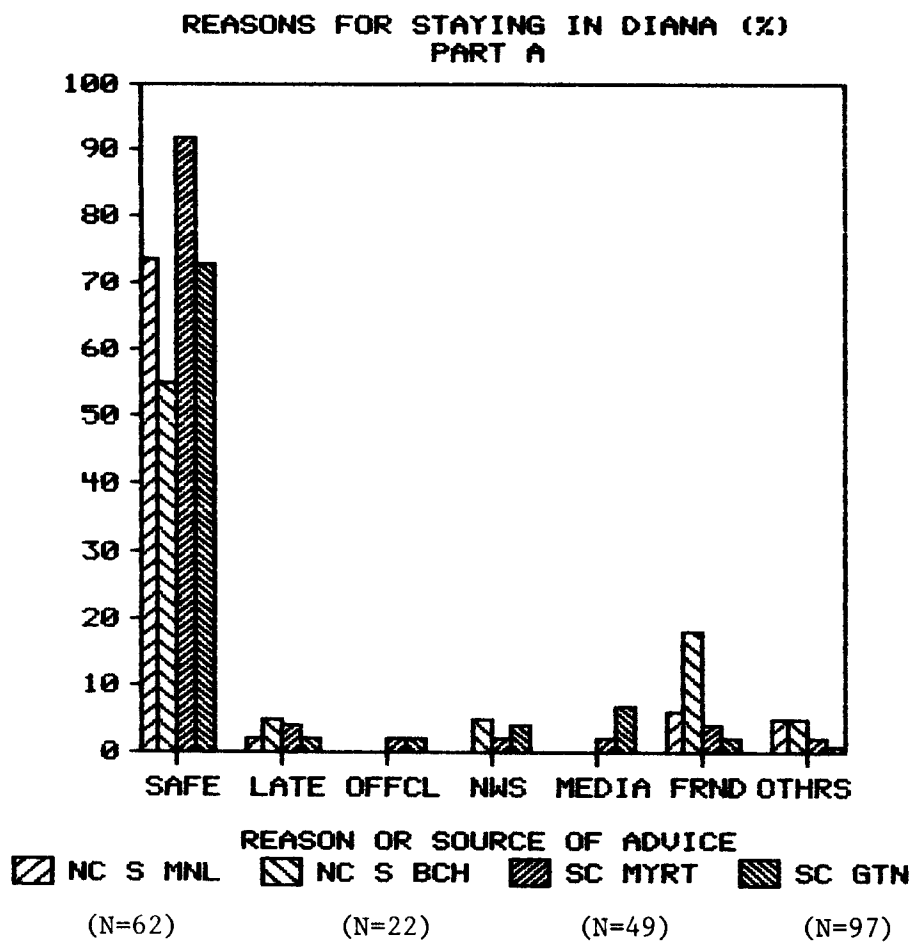


Figure 6B

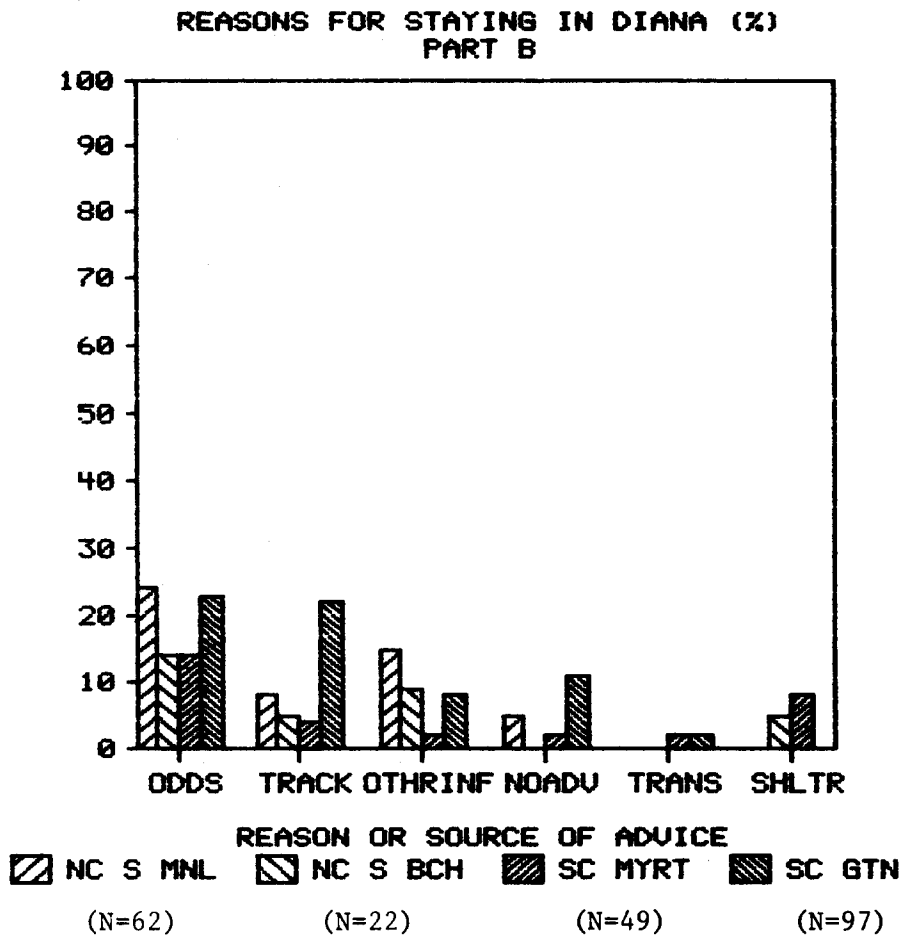


Figure 6C

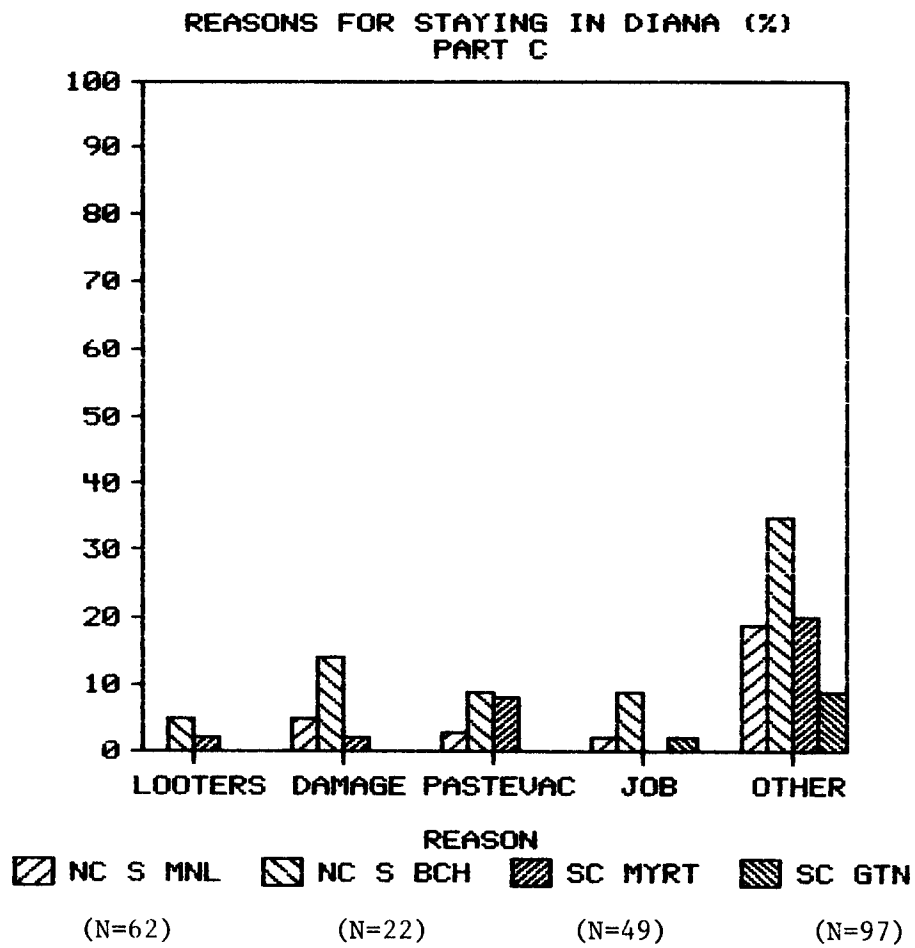


Figure 7

HEARD PROBABILITIES (%)

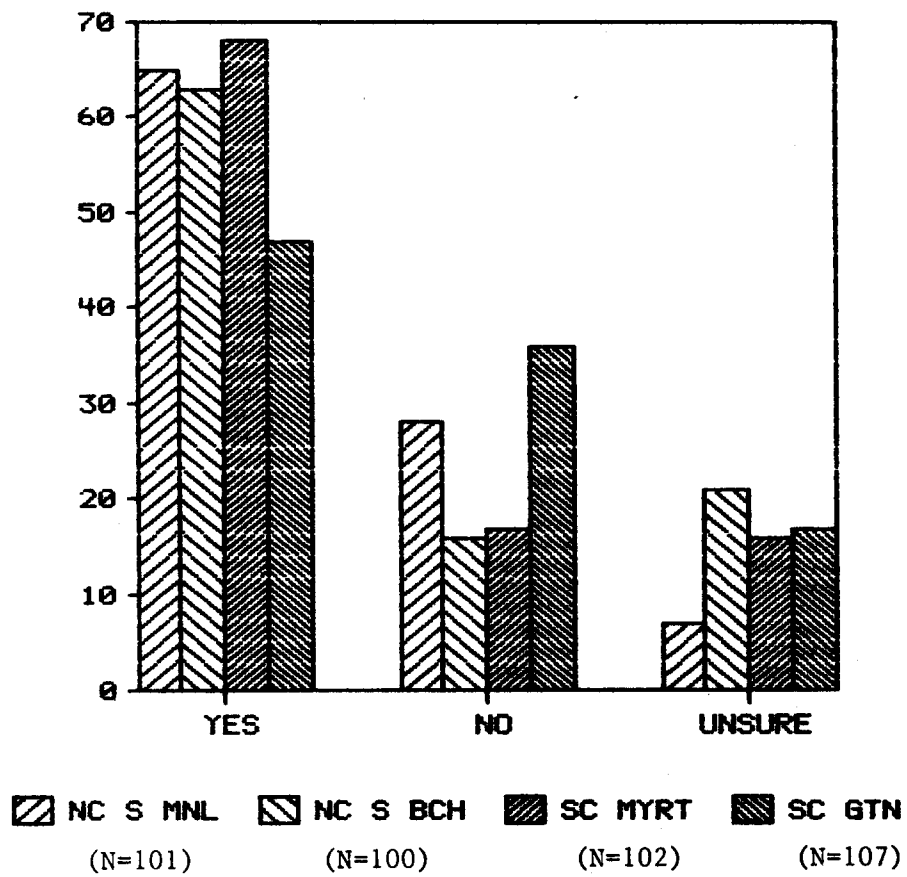
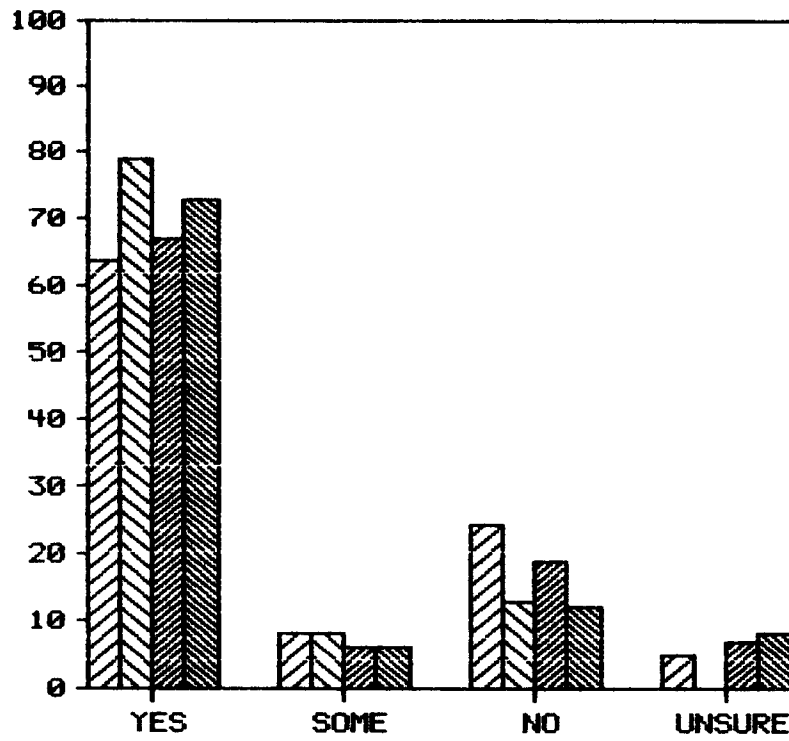


Figure 8

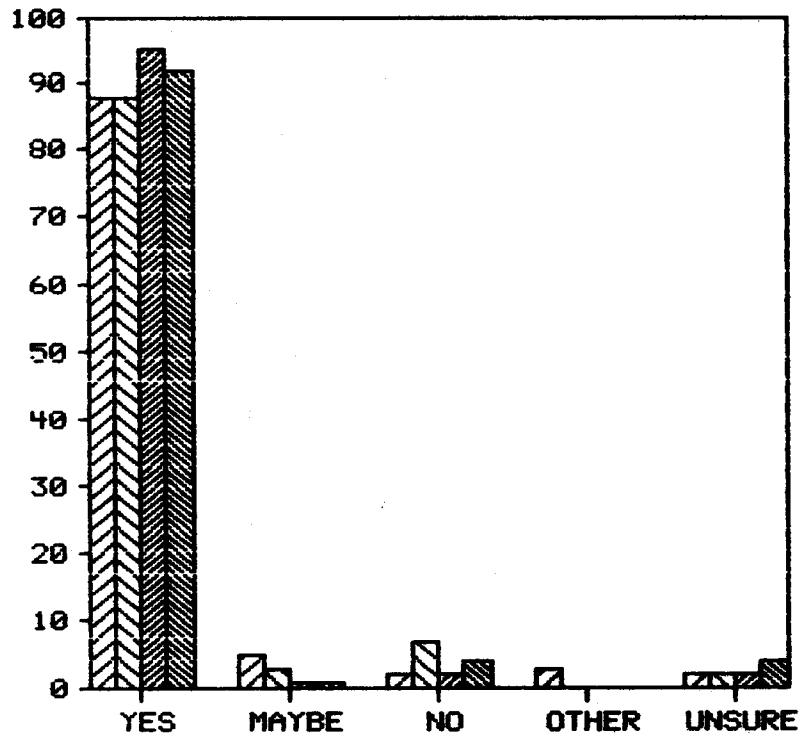
UNDERSTOOD NWS PROBABILITIES IN DIANA
(%)



NC S MNL (N=66) NC S BCH (N=62) SC MYRT (N=67) SC GTN (N=49)

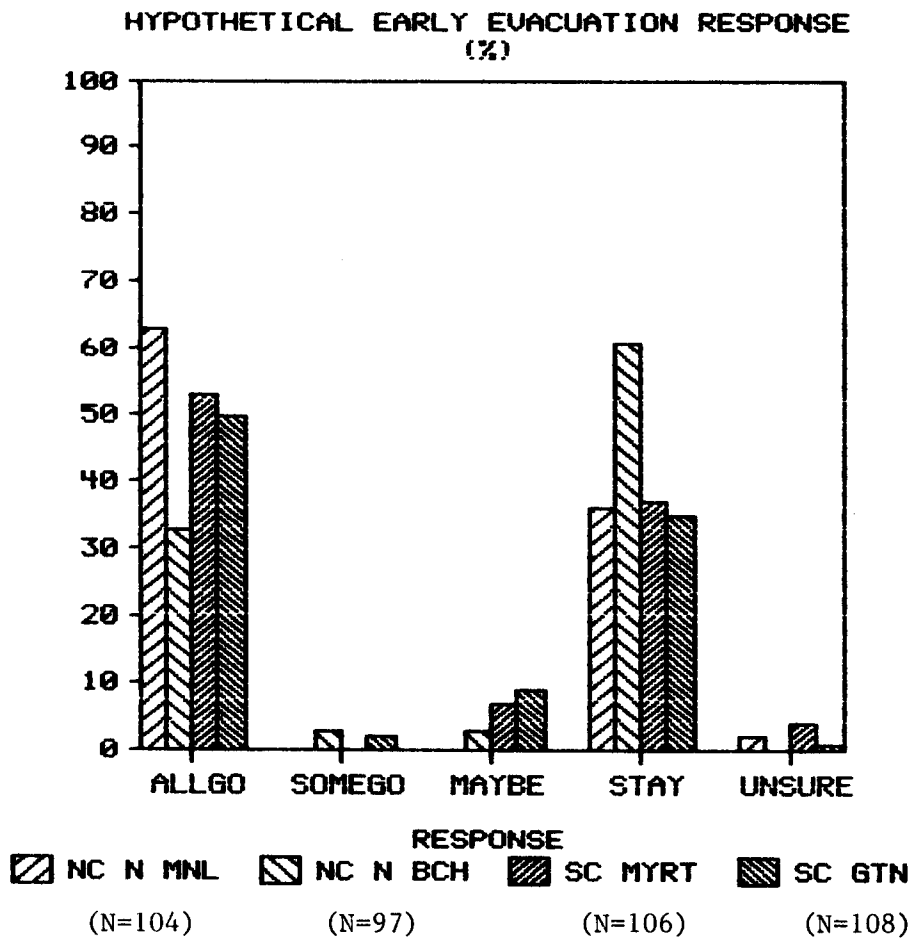
Figure 9

**BELIEVED NWS PROBABILITIES USEFUL
IN DIANA (%)**



[diagonal lines] NC S MNL (N=101)
 [cross-hatch] NC S BCH (N=100)
 [solid black] SC MYRT (N=102)
 [diagonal lines] SC GTN (N=107)

Figure 10



Actual Responses in Other Areas

In reviewing what people have done in past hurricane threats, one thing that becomes apparent is that there is a great deal of variation from place-to-place in the same storm and from storm-to-storm in the same place. The following are generalizations suggested from the patterns found in over a dozen evacuations before Diana.

First of all, there clearly is greater evacuation in the higher risk areas. Around 90% or better of the residents of areas near open beaches generally evacuate. This is probably a combination of awareness on the part of the residents of these areas as to their vulnerability and greater attention shown by public officials to these areas. Evacuation from what might be called moderate risk areas -- those near inlets, bayous, lakes, or several blocks from the coast but low-lying -- tend to experience somewhat lower evacuation rates: 60% to 80% as a rule. Again this is probably a consequence of lower concern with the risk by residents and less attention being paid to these areas by officials.

Good examples of this effect are Camille, Eloise, and David. In Mississippi during Camille the evacuation rate at elevations above 20 feet was 46%, while at elevations below 10 feet it was 92%. In Panama City Beach, Florida during Eloise 88% of the residents left, but on the "mainland" across the bay in Panama City proper the rate was 54% near the water and just 47% a few blocks inland. When David threatened the "Treasure Coast" area of Florida's southern shore (Indian River, Martin, and St. Lucie Counties), 78% of island residents evacuated, compared to 22% of the mainlanders.

The role of public officials in affecting response can't be emphasized too much. If you want people to evacuate, you need to tell them and make sure they heard and understood you. This will make more difference in response than any other factor with the possible exception of risk level of the area. Two illustrations are compelling: In the city of Mobile, Alabama where Frederic struck in 1979, the evacuation rate was only 34% in an area closely corresponding to the 100-year flood zone. In the areas where evacuation was advised, however, 63% evacuated. Of the Mobile residents who heard that they should evacuate, 84% left; of those who didn't hear that they should leave, only 20% did. In Miami and Miami Beach in David the difference was even more pronounced. Eighty-eight percent of those who heard they should leave did so, while only 8% of those who didn't hear they should leave did so. In Miami virtually all of the sample was in the area where evacuation was ordered.

Therefore, even in high-risk areas, don't take a high response rate for granted. Make sure that people in those areas know that they have been advised to evacuate, and the more personalized the warning, the better. Going door-to-door is probably the most effective strategy, and it's likely to have had much to do with the 97% response rate in Pensacola in Frederic where it was used a great deal. The next best approach is to pass through neighborhoods with loudspeakers. The least effective approach is putting out a bulletin over the media that "low-lying areas" should leave.

We noted above that evacuation rates in highest-risk areas tend to be upwards of 90% and in moderate-risk areas around 60% to 80%. Substantial evacuation sometimes occurs in low-risk areas also -- lower rates than in the other areas, but high enough to increase traffic congestion. Unfortunately these have not been so extensively documented as those in higher risk areas. As we mentioned above, of the Harrison County, Mississippi residents living above 20 feet, 46% evacuated in Camille when

tides were forecast to be 15 to 20 feet. Camille, of course, is a difficult storm to generalize from, given its rare intensity, but in Eloise 47% of Panama City residents on relatively high ground and several blocks inland evacuated, and on Florida's "Treasure Coast" in David, 22% of the low-risk residents evacuated. We believe it's fair to say that at least 20% of the low-risk area residents evacuate, and in areas closest to high- or moderate-risk areas the figure is around 40%. All three of the above examples were "impact" areas, that is, areas where the storm actually hit. Low-risk area evacuation rates further from impact areas are probably lower; it is our belief that people in low-risk areas probably evacuate later than people in high-risk areas, as we will discuss in the next chapter.

The evacuation rates we found in Diana are consistent with the generalizations stated above, given the severity of the threat, the vulnerability of the areas surveyed, and the actions taken or not taken by public officials. Officials in the Myrtle Beach area only advised evacuation (i.e., they didn't order it) and only in the beachfront areas. No evacuation was advised in Georgetown. People's perceptions of whether they had been advised to evacuate generally reflected these facts. The 9% leaving home in Georgetown could be a good indication of what goes on in a relatively low-risk area away from where the storm is expected to hit. In the northern NC area, where the Diana threat was low and officials did not advise evacuation, 10% to 15% of the residents of both the mainland and beach areas left.

Conclusions

1. In the high-risk areas of South Carolina -- especially beachfront areas -- the evacuation rate will be over 90% if major efforts are made to get word to those residents that they should leave, particularly if an order is issued or if the advisory is very strongly worded and the message is disseminated relatively personally. Rates closer to 80% will probably result in moderately severe storms if only moderate efforts are made to get people to leave. These figures would apply to the Myrtle Beach area east of Highway 17.

2. In moderate-risk areas -- low-lying but several blocks from the open coast or near inlets and other water bodies -- the evacuation rate will be around 60% if slight to moderate efforts are made to evacuate the areas and up to 80% or 85% if serious efforts are made. This is a risk area which probably merits closer attention from public officials during a threat in the future than they have generally received in the past. These figures would apply to the higher risk areas of Georgetown and to parts of the Myrtle Beach area west of Highway 17.

3. Low-risk areas will evacuate significantly less than high-risk areas, and the extent will depend upon how low the risk is (40 feet elevation vs. 20 feet, for example), how distant the area is from high-risk areas where evacuation is occurring, whether the storm is expected to affect the area, and how substantial the construction is believed to be in the areas. The latter point could be correlated with socio-economic characteristics of the area. Given the most likely warning scenario, we would use a rate of 20% for the lowest risk areas of coastal communities and 40% for the "highest of the low risk." Recall, for example, that almost 40% of the Myrtle Beach residents west of Highway 17 evacuated

in Diana without being told. Both these figures apply to low-risk areas near high-risk areas where evacuation is occurring. Further away the rates will be 10% or less.

4. The above conclusions are based upon patterns observed in evacuations observed elsewhere in the United States over the past 25 years. Collecting data following Diana allowed us to ascertain whether responses to Diana conformed to the patterns which have been observed in other locations, and the Diana responses in the Carolinas were very much what we would have predicted, given the storm threat situation and action by public officials. That comparison gives us increased confidence in applying the generalizations stated in points 1 through 3 above to the Grand Strand area. We would also note that relying solely upon the survey responses to the hypothetical threat situations would have led to overprediction of evacuation rates in Diana.

Vacationers

Interview Results

Table 1 lists the states of residence of the Grand Strand vacationers whom we interviewed. The importance of Table 1 to vacationer evacuation rates is that most Grand Strand vacationers live within a day's drive of home, thereby making it practical for them to drive home from their vacation in less than a day. Ninety-five percent of the vacationers we interviewed drove to the Grand Strand, and 96% had access to a car while there. Sixty-five percent came with family, 21% came with friends, 9% came with both, and 5% came alone.

Table 1. States of Residence of Vacationers

<u>State</u>	<u>Percent</u>
North Carolina	24
South Carolina	19
Virginia	11
Pennsylvania	7
Georgia	7
Ohio	6
West Virginia	4
Maryland	3
Kentucky	3
New York	2
Indiana	2
Alabama	2
Other	9

Figure 11 depicts people's responses when asked whether they had ever given any thought to what they would do if a hurricane threatened their location while they were on vacation. In South Carolina almost 60% said no, and 13% said they had given it only a little thought. The answers could be important in deciding how much confidence to place in the respondents' replies to hypothetical threat questions. It's interesting to note that vacationers in North Carolina were more likely to say they had given some thought to what they would do in such a situation.

When asked whether they thought the lodging where they were staying would be safe in a hurricane, over half said no, about 8% said it would depend on the storm, and 20% were unsure (Figure 12). Only twenty percent said they thought the place where they were staying would be safe.

The first hypothetical threat we described to respondents was the same as the first we described to residents: a fairly weak storm, the area was under a watch, and officials hadn't advised evacuation. We added, however, that the weather at the time was good. Given that situation, about 20% said they would leave for home, about 5% would either leave for another vacation area or evacuate to a nearby location, and 15% would ask the management where they were staying what they should do (Figure 13). Given the same threat information but windy, rainy weather, 26% said they would be more likely to leave, bringing the total evacuation to 50%

Figure 11

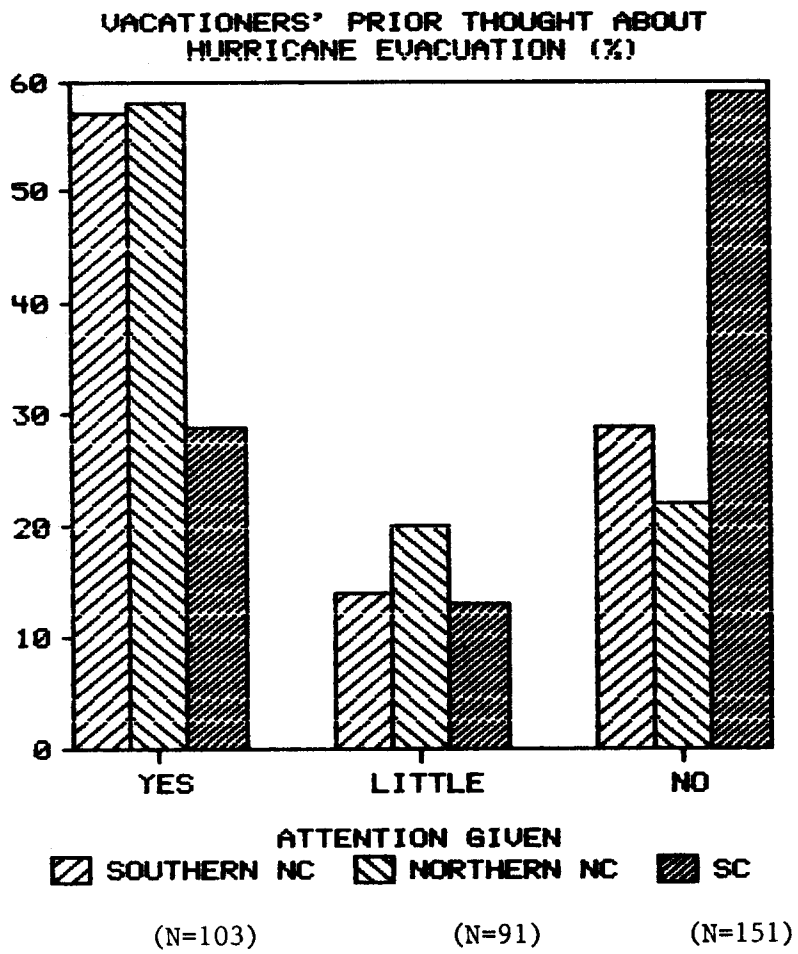


Figure 12

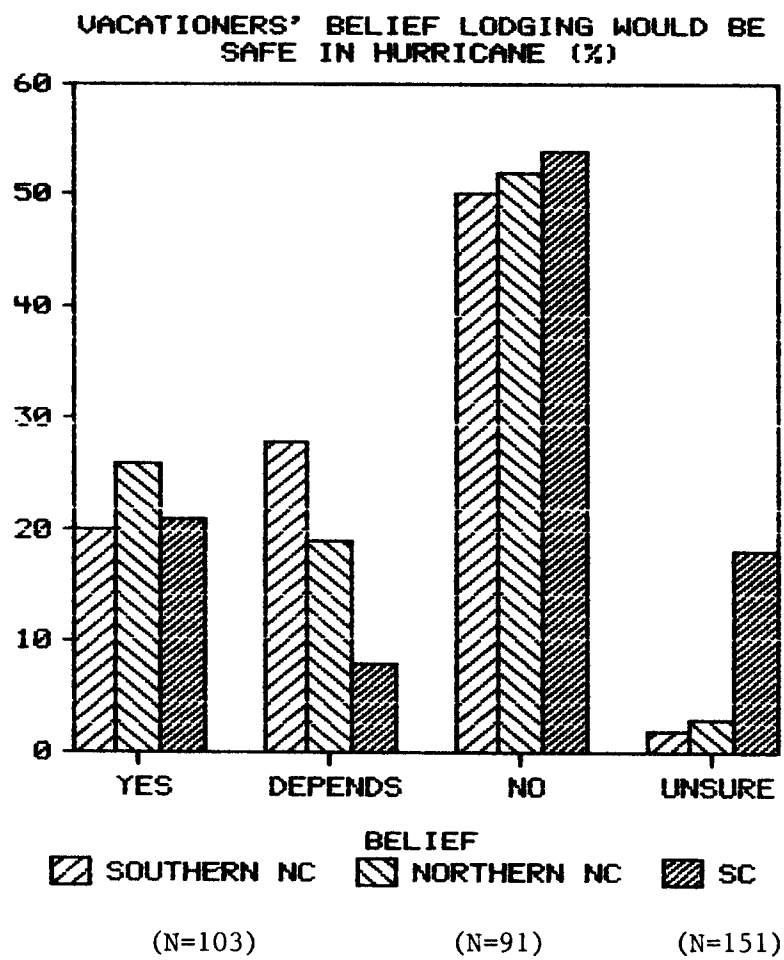
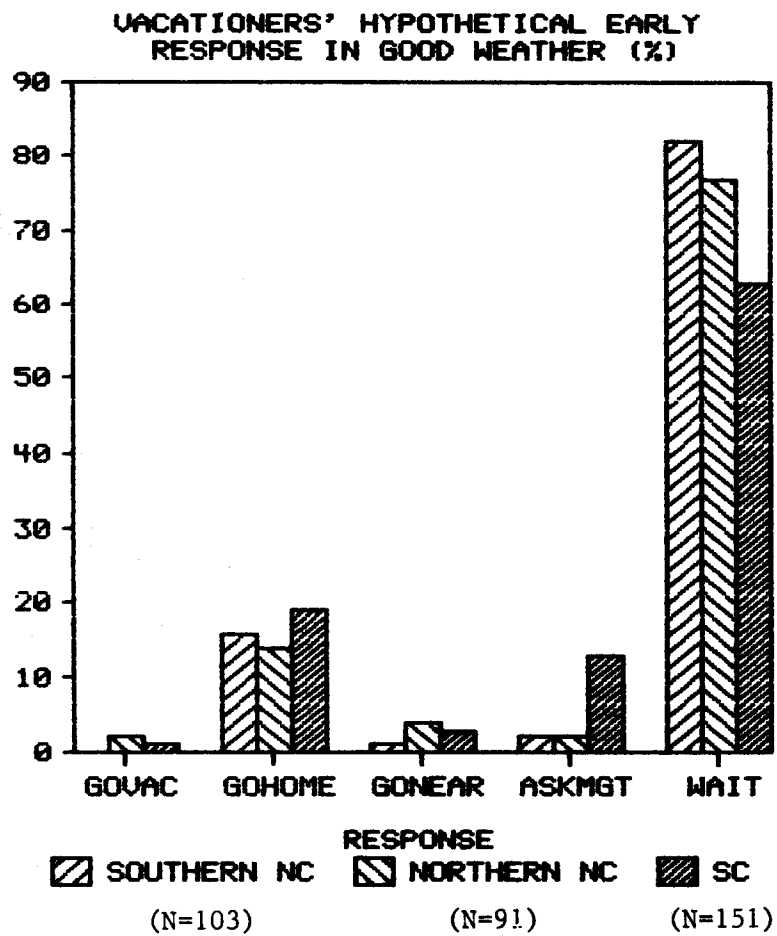


Figure 13



(Figure 14). Here it is worth noting that this "bad weather threat" elicited less intention to evacuate in the Grand Strand area than in North Carolina, particularly in the southern beach area of North Carolina. This could be due to the fact that in North Carolina evacuation home is even more feasible than in South Carolina, as 75% of the southern North Carolina vacationers live in North Carolina.

When posed with the prospect of a worse storm, a warning, and local officials having advised evacuation, 10% of those who hadn't said they would evacuate in the two earlier threat situations said they still wouldn't leave at that time, 20% said they would go someplace nearby, and 8% said they would ask the management for advice (Figure 15). Over 60% said they would evacuate out of the area. Thus, only 5% of the total vacationer sample claimed they wouldn't evacuate in this scenario.

Only 11% of the sample said they had been in the area before when there was a hurricane threat. Half said they evacuated in those threats.

Results from Other Locations

The only other survey of vacationers of which we are aware was conducted on St. George Island, off the coast of northwest Florida. The development is extremely low density, with most visitors coming from within 100 to 150 miles. The hypothetical response results were very similar to those found in the Carolinas, with only 3% saying they wouldn't evacuate if told to do so by public officials.

Conclusions

1. In a serious threat at least 90% to 95% of vacationers can be expected to leave the places where they are staying if officials take measures to urge their departure. Even without aggressive action by officials we expect over 80% to evacuate, particularly if the weather is poor or likely to turn poor even if the hurricane misses the area.

2. Vacationer behavior is the most poorly documented type of hurricane response, and not too much confidence should be placed in vacationers' answers to hypothetical threats. Although we believe the above numbers to be the most likely, it would be prudent for planners to test the sensitivity of evacuation simulations to different assumptions regarding tourist response.

3. Although no systematic data is available concerning vacationer response in Diana, interviews with hotel, motel, and campground managers seem to indicate that response in Diana was consistent with the above numbers.

Figure 14

**EFFECT OF BAD WEATHER RATHER THAN GOOD
ON VACATIONERS' PLAN TO LEAVE EARLY (%)**

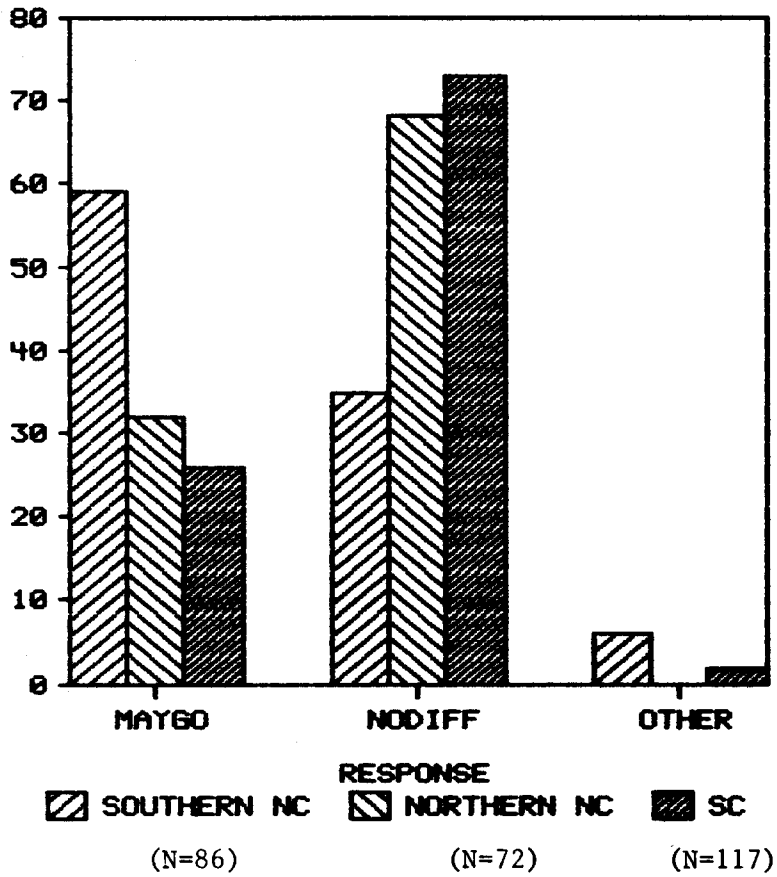
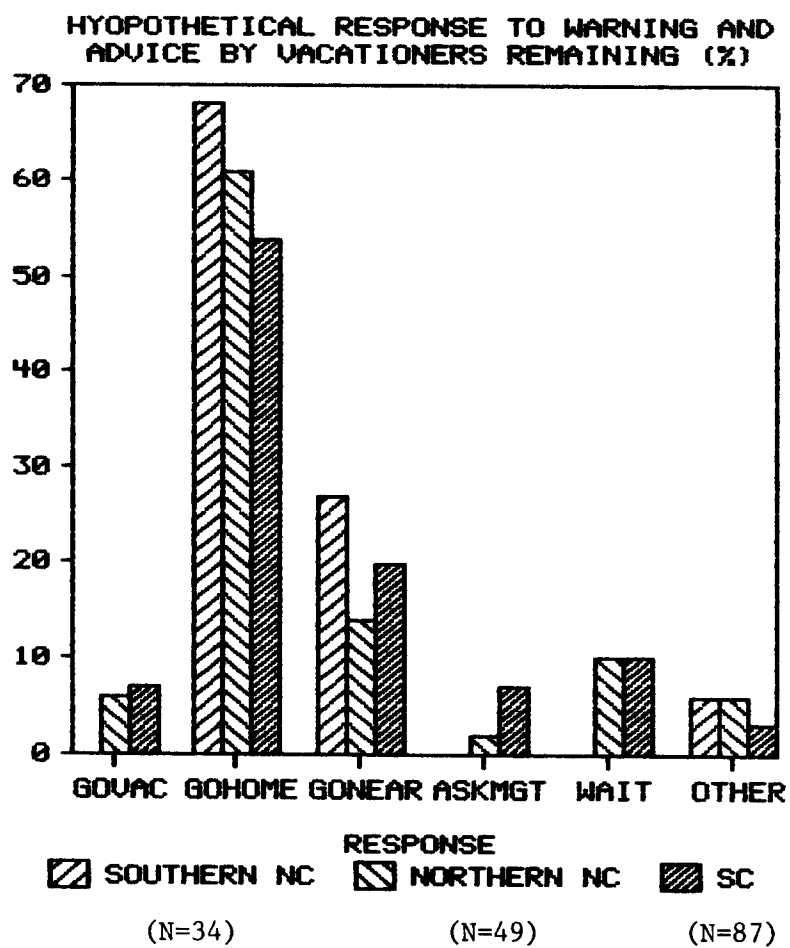


Figure 15



EVACUATION TIMING

Transportation simulations have shown that the total time required to evacuate a population can vary depending upon the rate at which evacuees load the transportation routes. This section addresses the response curves -- i.e., the percent of evacuees who will leave at various times -- which will pertain in various situations.

Residents

Surveys Following Diana

Figure 16 shows the cumulative evacuation curve for the Myrtle Beach area, and Figures 17 and 18 show the curves for the southern North Carolina beach and mainland areas respectively. People began leaving on the morning of the 10th, and by midday on the 11th 15% of the eventual evacuees had gone. That token early response was probably in response to the hurricane warning which was issued by the National Hurricane Center at 9:00 AM on the 10th. The evacuation began in earnest around noon on the 11th, roughly coinciding with the issuance of the evacuation recommendation by public officials. The evacuation rate leveled off on the evening of the 11th, and few left the following day while Diana was stalled offshore. The final 25% of the evacuees left late on the 12th or in the early hours of the 13th when the storm resumed its movement toward shore. Similar responses were observed in North Carolina.

Hypothetical Responses

Probably the least meaningful hypothetical question you can ask of people is when they would leave if faced with a hurricane threat. About the best you can do is pose the respondent with a variety of threats which tend to vary with respect to proximity to landfall time and see how many people would leave in each situation. Unfortunately we have found that more people tend to say they would leave in low (i.e., early) threat situations than really do. Half the respondents in our samples in the Myrtle Beach and Georgetown areas said they would leave during a watch without being advised.

Hypothetical Responses in Other Locations

As we noted earlier in the discussion of evacuation rates, surveys in northwest Florida, Alabama, and Mississippi found that 60% to 70% of the respondents said they would leave early -- i.e., during a watch without advice from public officials. The figures are only slightly higher than those from the South Carolina sample locations.

Actual Response Curves in Other Areas

In reviewing cumulative evacuation response curves from actual evacuations in past storms outside the Carolinas, several patterns stand out. First of all, one is struck by the diversity in slopes and shapes of the curves. Clearly, there is no single curve which one should assume. The main factor accounting for variation in the curves appears to have been action by public officials, which in turn was tied to things such as severity of the storm, officials' belief the storm would hit their area,

Figure 16

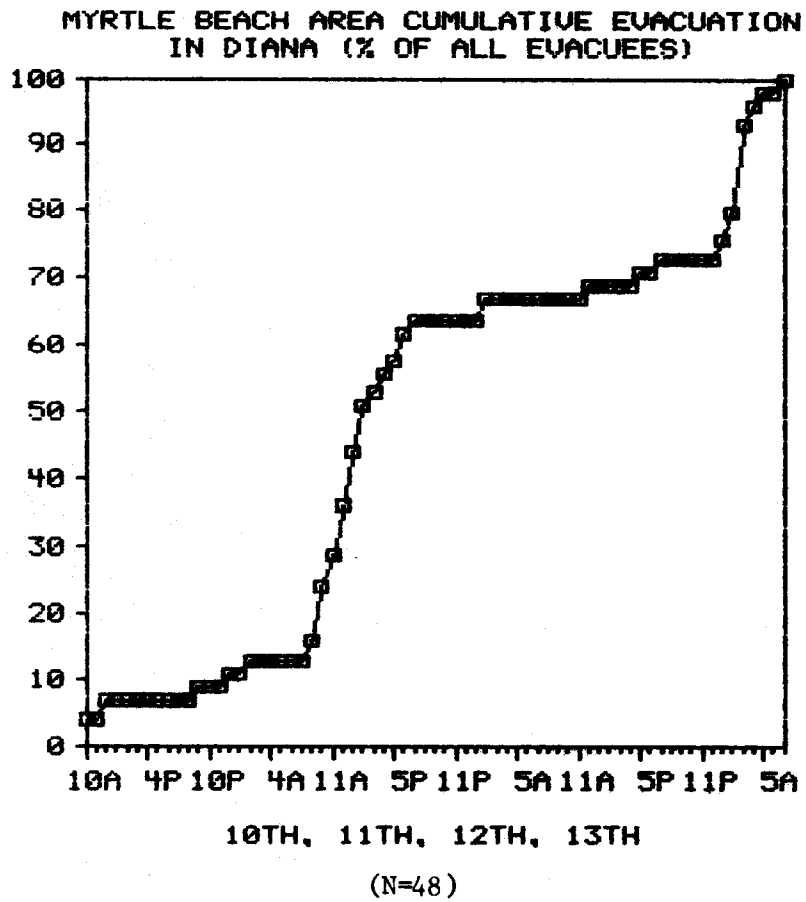


Figure 17

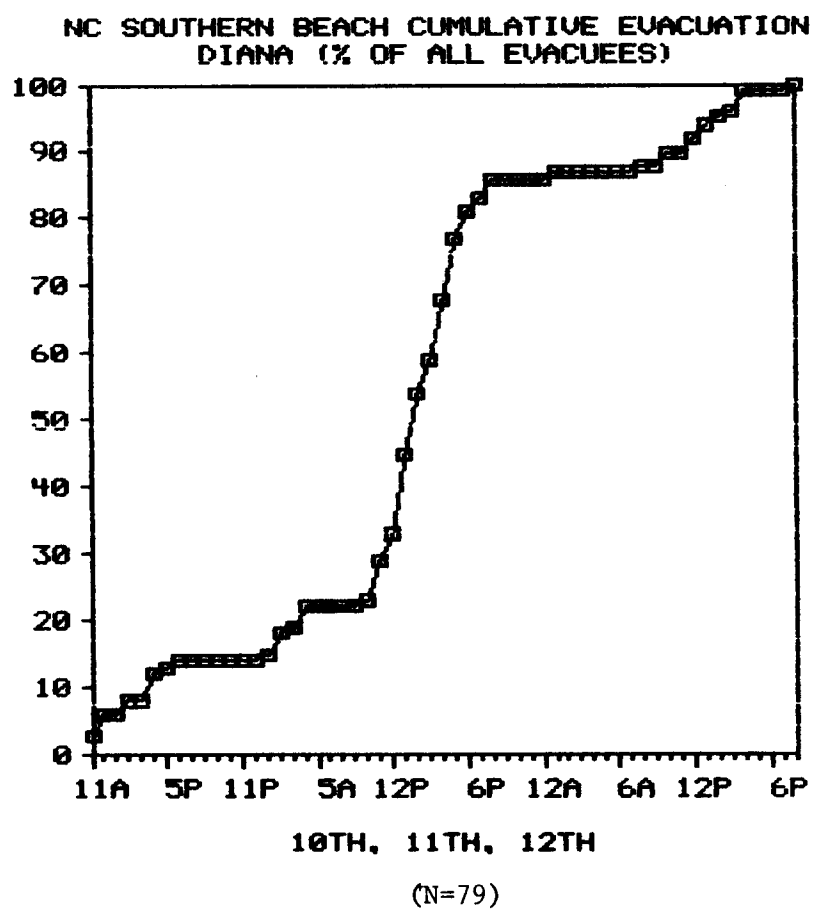
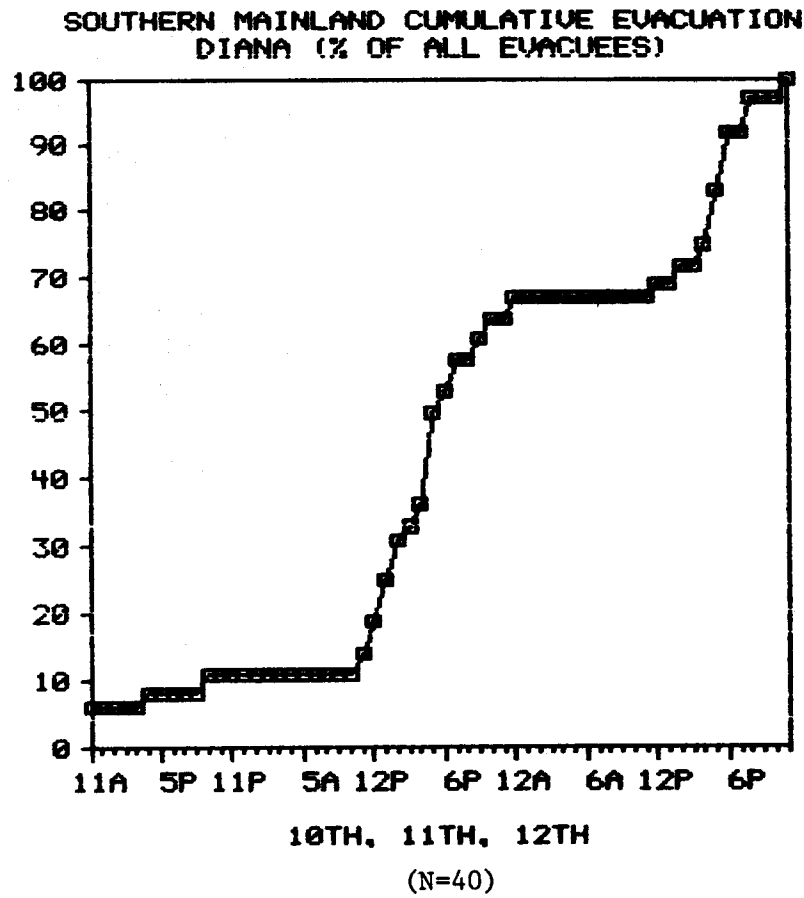


Figure 18



and the evacuation difficulties of their area. The point is this: In most cases very few people evacuated before being advised to, but when advised -- even if the advice came well before expected landfall -- people responded. Only in Miami in David did a sizeable chunk of evacuees leave before being advised, and recall that only 38% of the sample evacuated, that the storm missed, and most people didn't hear that they were being advised to evacuate. Had the advice reached everyone and had the storm turned more toward Miami, the total evacuation rate would have been higher, leaving a much lower percentage of the evacuees who left before the order.

Sharp increases in slope followed advisements or orders in almost all of the storms. One of the most impressive was Grand Isle, La. where officials advised residents to leave more than 36 hours before Frederic eventually made landfall in Alabama. Ninety-four percent of the residents evacuated, and 70% of them left the day of the advice. Grand Isle is a very high risk area whose evacuation routes can be flooded well before the storm hits or even if it comes any place close. Therefore officials urge residents not to take any chances. Pensacola, Florida also had a very successful evacuation in Frederic, with 96% of the high-risk area residents leaving. Pensacola officials, however, felt they could wait until 12 hours or so before landfall and still get everyone out who needed to get out. Mid- to late-morning on the day of the storm officials went very aggressively through neighborhoods ordering evacuation, and the result was a very steep response curve. Depending upon the needs and capabilities of a particular area, officials can pretty much determine the shape and slope of their response curve.

It should be remembered that when one says that evacuation would have to begin 24 hours before landfall in order to get everyone out safely, you don't want everyone leaving 24 hours before landfall. Some people will respond immediately after the advisement or order, while others will take longer. Even the immediacy of response can be influenced by the urgency and aggressiveness of the advisement. We don't believe, by-the-way, that the distinction between an order and advice is as important as some people do. The important dimensions are urgency and aggressiveness, as we mentioned above. You can make advice sound awfully urgent without calling it an order, and if an order is not aggressively communicated, it will be ineffective.

In addition to the effect of officials' actions upon evacuation timing, time-of-day also proves to be significant. In Pass Christian, Mississippi in Camille; in Panama City and Pensacola, Florida and Grand Isle, Louisiana in Frederic; and in Galveston, Texas in Allen and Alicia there was a notable jump in evacuation behavior upon morning. In some cases these times were coincidental with other events such as official advice, but in Galveston's Allen evacuation and Grand Isle's Frederic evacuation the phenomenon was obvious. There were increases in activity until near bedtime (9 or 10 PM) when the curves leveled off until around 6 AM when activity increased again. If it's not urgent, people will wait until morning to leave. The Panama City evacuation in Eloise showed, however, that when necessary, people will leave in the wee hours. Over 80% of the evacuees in that event left after midnight.

Looking at the lag between when people say they heard they should evacuate and when they actually left also reveals a great deal of variation from one evacuation to the next. These lags manifest themselves in the sorts of response curves discussed earlier.

The response curves found in Diana are striking in their conformance to the generalizations stated above from Gulf Coast evacuations. The curves didn't rise significantly until public officials had advised evacuation, then they rose steeply; the time-of-day effect was also apparent.

Conclusions

We don't believe the responses that 50% of the permanent residents will evacuate during a watch before being advised or ordered. Note how few residents evacuated even under a warning before the beach area was told to evacuate by public officials. We were fortunate to have the opportunity to document the actual response curves in the Myrtle Beach and southern North Carolina areas in Diana, but as valuable as the documentation is, we must remember that it is probably peculiar to the specific threat situation posed by Diana and that different threats would probably result in different curves. The greatest value of the curves found in Diana is that they are consistent with the sort of patterns found elsewhere in other evacuations, giving increased confidence in our application of those generalizations to North Carolina.

1. The single most important factor affecting when people begin evacuating is advice or orders from public officials; very few people leave before being advised to.

2. For planning purposes we recommend that preparedness professionals in each part of the study area consider the most likely threat situations to affect his area, the warnings likely to be given, and the timing of his advice to the public, and infer a response scenario based upon those assumptions. We further recommend that more than one threat situation be simulated in each location to assess the sensitivity of total time required for evacuation to such assumptions. The following general response curves should be considered:

- A. Optimistic but realistic, assuming early, aggressive action by public officials: "S" shaped curve, with an order given 14 hours or more before landfall, rapid response by the public, with 60% to 70% of evacuees leaving within the next 4 to 6 hours.
- B. Cautious but realistic, assuming marginally early, moderately aggressive action by local officials: Linear or "J" shaped curve, with order given 10 to 12 hours before landfall, fairly good public response, with 40% to 50% of evacuees leaving in the next 4 to 6 hours.
- C. Worst case, assuming late but aggressive action by local officials: Sharply "J" shaped, with order given 6 to 8 hours before landfall, rapid response by the public, with 50% of evacuees leaving during the next 2 to 4 hours.

3. In choosing threat scenarios to plan around, we suggest that the time-of-day factor be considered, as special efforts are needed to overcome the tendency for evacuees to wait until morning to leave.

4. We are not aware of separate response curves for high- and low-risk areas in the same vicinity, but we believe it's fair to assume that evacuation tends to begin earlier in highest risk areas. Part of the reason for this is that officials often urge it earlier in these areas (i.e., "phased" evacuation). We suspect, however, that "spontaneous" evacuation (i.e., in the absence of official advice) is higher in the areas as well, due to residents' awareness of the vulnerability of evacuation routes. There is support for this notion in the Diana curves for the North Carolina southern mainland and beach areas.

Vacationers

No actual response curves for vacationers have been documented, as far as we know. Vacationers' hypothetical responses suggest that most will leave early (during a watch without advice from public officials) if the weather is poor but not if the weather is good. The confidence we should place in those answers is simply not known, as we have no reliable actual response data to compare it to. Interviews with officials and hotel/motel operators in the Carolinas suggest that in Diana vacationers left at least as early as residents. Of the 20 hotel/motel operators who returned questionnaires, only three reported as many as 20% of their guests leaving on Monday the 10th. Only one of the seven campground operators reported even a few campers leaving before Tuesday.

Conclusions

1. For planning purposes we would make the same assumptions about vacationers as residents but perhaps have a slightly steeper slope for the vacationers' curves, reflecting their possible propensity to leave a bit earlier even in good weather.

2. We would also assume that if the weather is poor during the threat -- even if it is unrelated to the storm system -- and is expected to remain so for the next couple of days, more vacationers will leave early. Little if any evacuation is likely to occur in the absence of at least a hurricane watch or some form of severe weather notice (e.g., gale warnings).

3. Vacationers might be more susceptible to what some people call the shadow effect in an evacuation -- where evacuation is taking place in one location and people nearby begin their own evacuation even if their risk is lower and officials haven't recommended that they leave. Thus, if the southern beaches of North Carolina are evacuating, some number of vacationers are likely to start leaving from Grand Strand beaches also, even if officials haven't advised it.

TYPE OF REFUGE

To anticipate shelter demand and to help project evacuation routes to be used, estimates of the proportion of evacuees who will use public shelters, go to friends' or relatives', etc. are necessary. This chapter provides those estimates for South Carolina.

Residents

Surveys Following Diana

Figure 19 indicates that only 23% of Myrtle Beach evacuees took shelter at public shelters, and similar numbers were reported in the mainland area of southern North Carolina. Almost half the Myrtle beach respondents who left went to friends' or relatives', with about 26% going to motels. In southern North Carolina the mainland results were similar with respect to friends but lower with respect to motels. Sixty percent of southern North Carolina beach residents went to friends', while about 15% went to motels. The "other" category includes churches, public buildings not operated as official public shelters, and workplaces. Use of such facilities was much lower in South Carolina than in North Carolina.

One of the most interesting things about the Diana evacuation was the length of time evacuees had to be sheltered, with most having evacuated on the 11th and the storm not hitting until late on the 13th. Very few respondents complained about shelter conditions, however, and we had no indication that more than a few who had used public shelters in Diana wouldn't do so in the future. We should note, however, that most evacuees did not stay at their place of refuge the entire time. Figure 20 shows that 25% of the Myrtle area evacuees returned home on the 11th and 30% on the 12th. (The most common reason being advice from public officials or the belief that the storm had missed. Most early returners evacuated a second time.)

Nonevacuees' Hypothetical Response

Of the residents who didn't evacuate, between 35% and 40% of both Myrtle Beach and Georgetown residents said they would have gone to public shelters if they had left (Figure 21).

Pre-Diana Hypothetical Surveys

In interviews conducted before Diana residents were asked where they would go if they evacuated, given an order, and Figure 22 shows the responses. Note that a few, as we mentioned earlier, insisted that they wouldn't leave. About 35% of the Myrtle Beach sample and a whopping 57% of the Georgetown said they would use public shelters, and almost 20% in Myrtle Beach and 6% in Georgetown said they would go to motels. Those who responded that they would go to public shelters or motels were asked if they had friends or relatives in safe locations where they could go, and about half said yes or maybe. When prompted, over 60% of those respondents said they might in fact stay with the friends or relatives rather than going to a public shelter or motel.

Figure 19

TYPE OF REFUGE USED IN DIANA (%)

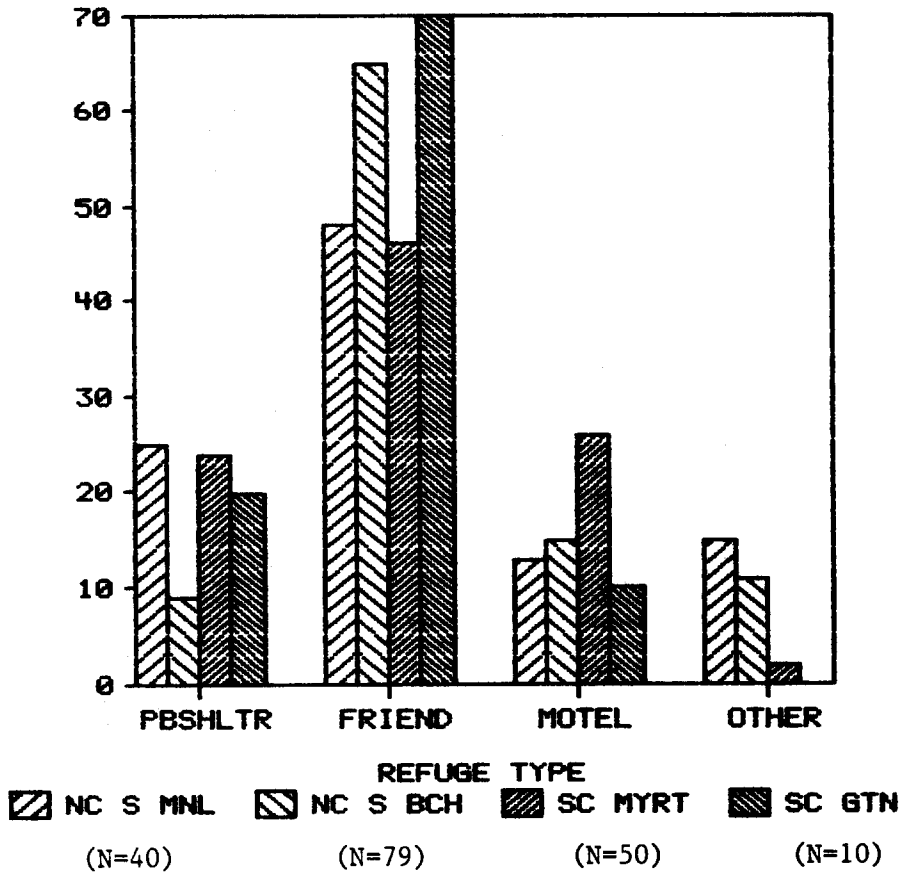


Figure 20

WHEN DIANA EVACUEES FIRST RETURNED HOME (%)

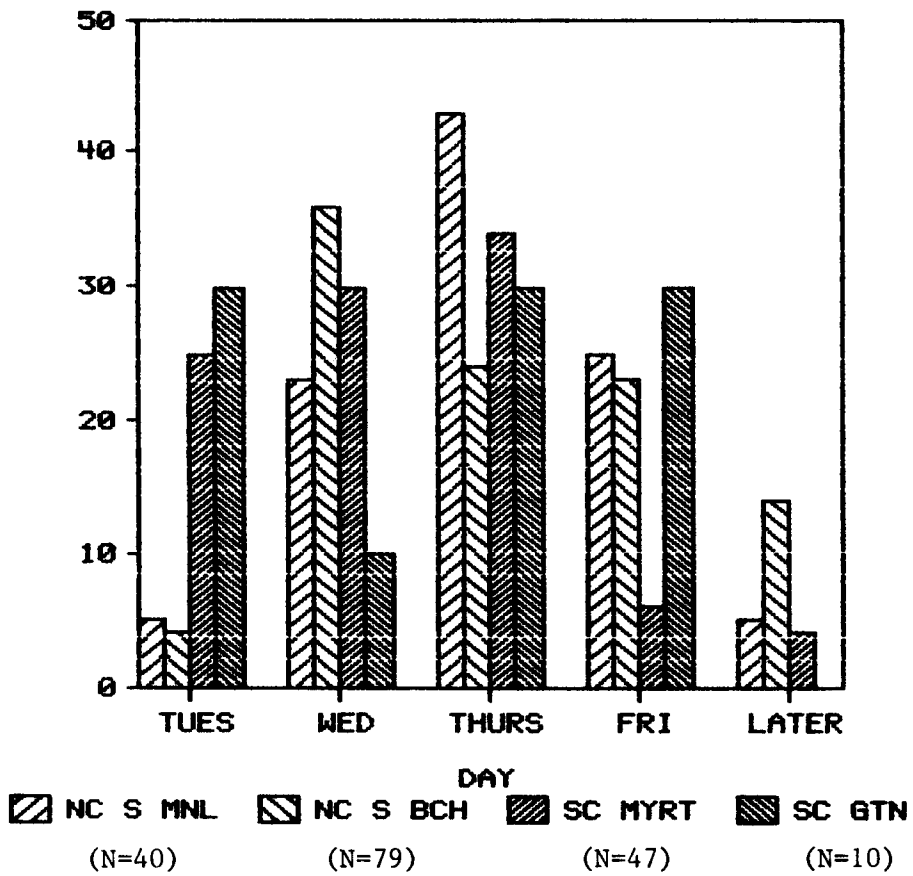


Figure 21

DIANA STAYERS' HYPOTHETICAL REFUGE (%)

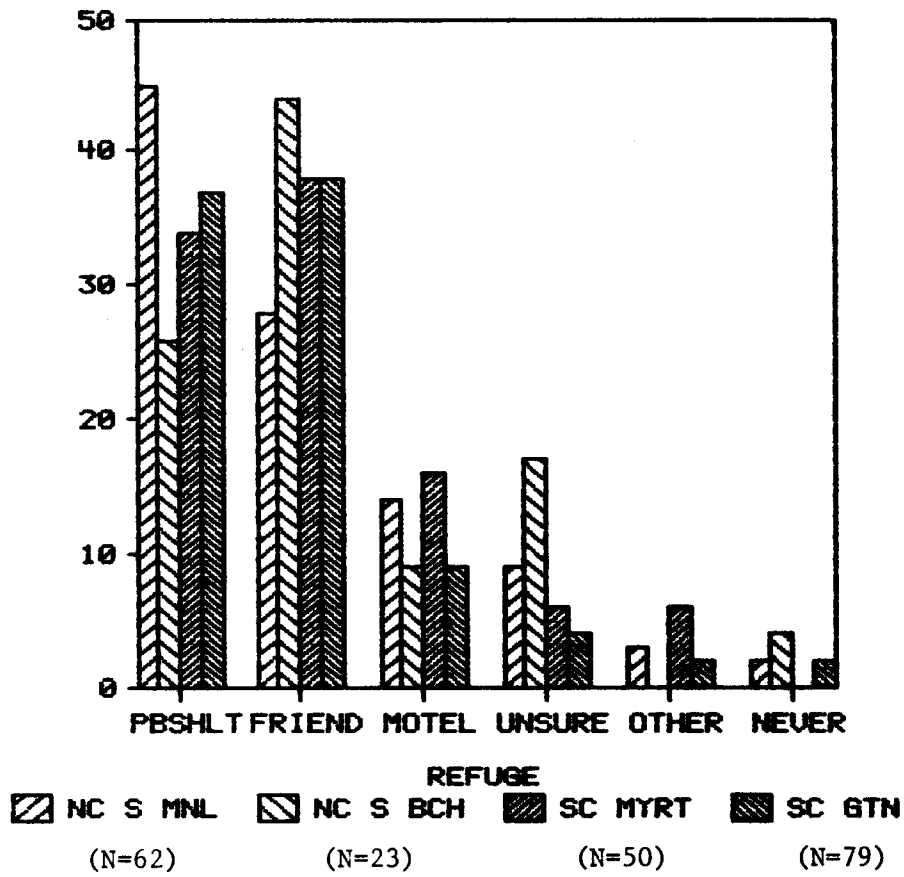
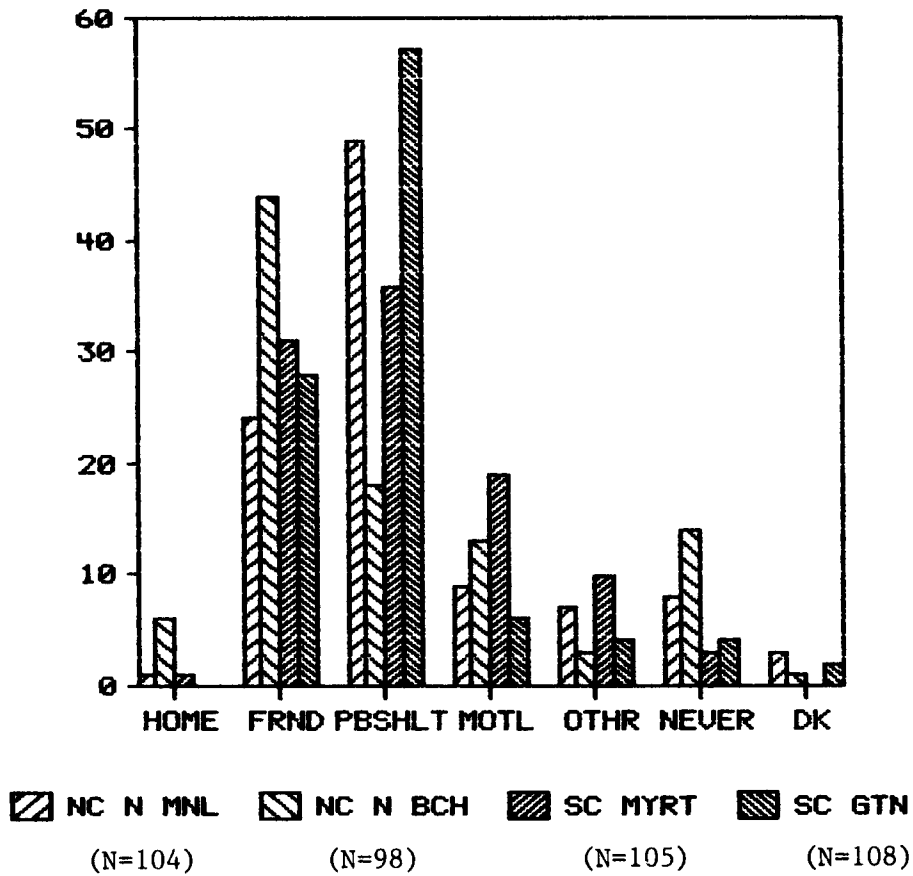


Figure 22

HYPOTHETICAL REFUGES (%)



Hypothetical Responses in Other Locations

In hypothetical surveys in other beach and mainland coastal locations (mostly in Florida, Alabama, and Mississippi) about 25% of the respondents usually say they would use public shelters, 30% to 45% say they would go to friends' or relatives', 15% to 25% say they would go to motels, and 15% to 20% say they are unsure where they would go. There are extremes above and below those figures, but most are very close. We have also observed that residents in lower risk areas are more likely to say they would use public shelters than people in high risk areas. Interviews with inland residents in Florida, for example, showed that 45% of the respondents said they would use public shelters. In Harrison County, Mississippi 40% of the people who lived several blocks inland from the beach said they would use shelters, compared to 17% of the residents who lived in higher risk areas. In Pensacola, Florida the figures were 42% in the low-risk area and 7% in the high-risk area. This is consistent with the higher percentage of Georgetown residents than Myrtle Beach residents saying they would use public shelters, and a similar pattern existed between beach and mainland areas in North Carolina.

Actual Response Studies

Shelter use in actual hurricane evacuations has been significantly lower than the use rates indicated in hypothetical responses in both North Carolina and other locations. In the Galveston evacuation in Carla around 10% or less stayed in shelters, although more stayed in public buildings not operated as public shelters. In Frederic the highest shelter use was in Pass Christian, Mississippi, but even there it was only 13%. Grand Isle and Pensacola were around 2%. The highest shelter use rate documented in any of the actual response studies was 31% in Harrison County, Mississippi in Camille. This probably had much to do with the extreme severity of the storm and the fact that some evacuees decided late to leave home and had little time to arrange or reach alternative shelter. Shelter use in Galveston was higher in Alicia than in Allen, primarily because Allen was much more severe and the evacuation was earlier, thus convincing evacuees to go further inland for safety. A 12% shelter use rate in Miami in David counters the idea that shelter use in places like South Florida would be high due to the absence of social ties throughout the community, extended family, and so forth. It should be noted, however, that lack of an alternative shelter and unwillingness to use a public shelter could have contributed to the low evacuation rate in David in Miami.

In Carla up to 25% of the evacuees stayed with friends or relatives locally. Staying with local friends and relatives was lower in other locations in Carla, however. In Frederic the figures ranged from 20% to 32%. If you look at those who stay with friends and relatives both out-of-town and local, the figures are generally much higher. In Mobile in Frederic, Miami in David, and Galveston in Allen, 65% to almost 80% of the evacuees stayed with friends and relatives, and in Galveston in Alicia 50% did so. Only in Mississippi in Camille did as few as 30% stay with friends and relatives, reflecting also the abnormally high shelter use.

The 23% shelter use rate reported in the Myrtle Beach area and the 25% shelter use figure reported by southern mainland residents in North Carolina in Diana are toward the high end of shelter use figures documented in the past. The estimates, however, are based on only 40 to

50 evacuees in each location, and estimates from samples that small are usually accurate only within 15 to 18 percentage points of the "true" population value. Evacuees also constituted half or less of the threatened populations in the two areas and might not have been representative of the evacuees who would have left in a more complete evacuation. We make these points simply to caution against placing too much confidence in the 23% figure for future planning. The 9% figure from the North Carolina southern beach area is more typical of results elsewhere and is more statistically reliable than the mainland and Myrtle Beach estimates. It is interesting to note, though, that at least in our sample, shelter use was higher on the mainland than among beach residents in North Carolina.

Motel or hotel use has varied a great deal in evacuations. There was a low of 4% in Camille and a high of 24% in Alicia.

Conclusions

1. We believe that use of public shelters in South Carolina will generally be lower than responses to hypothetical questions indicated. Recall that when shelter and motel users were asked whether they had friends they could stay with, half said yes. Of those, over 60% said they would or might stay with the friends after all when prompted. During a threat friends and relatives tend to check on one another, and options for staying with one another become greater than survey respondents tend to expect. In Frederic 75% of a sample of Mobile residents said they checked on other people and others checked on them during the threat. In their hypothetical survey the Treasure Coast regional planning council in Florida found that 50% of their sample intended to stay in public shelters if they evacuated. When asked what they did in David, only 19% of the evacuees said they stayed in shelters. In the Myrtle Beach area, 36% of the residents said in a hypothetical survey before Diana that they would stay in public shelters. Of those who evacuated in Diana, only 24% went to shelters. (We would add the same cautions here that we noted earlier: the sample is small, and most people didn't evacuate.)

2. Although we don't believe the absolute numbers in the survey regarding shelter use, we do believe there's something to the apparent higher use rate among low-risk residents compared to high-risk residents. The difference is consistent across many different survey areas, but more importantly, in addition to the southern North Carolina Diana results, we found evidence to support the pattern in the Panama City, Florida evacuation in Eloise as well. We're not sure what would account for the difference, but the following are possibilities. People in lower income groups are more likely to use shelters than people with higher incomes, and low-risk areas away from water bodies and the beach probably tend to have lower incomes. People in higher risk areas probably leave earlier than low-risk area residents, so they might have more time to go out-of-town to stay with friends or relatives, while low-risk area residents might feel they can afford to wait-and-see whether the storm is going to hit before leaving because their vulnerability to the storm is relatively slight anyway. When they get around to leaving, though, there's no time to get on the road and go inland or maybe even across town to a friend's.

3. We suggest that planners take income and risk-area differences into account when anticipating shelter use and tailor the figures used here to their own locales, but we would use a figure of about 20% in the Myrtle Beach area and 25% in Georgetown. In barrier island beach areas the figure would be only 5% to 10%. These are higher than we recommend in most areas, and we have adjusted them upward based primarily on the sample responses of evacuees in Diana and the unusually high hypothetical use figure obtained in the pre-Diana survey in Georgetown (note that the post-Diana hypothetical shelter use figures in Georgetown were under 40%). These are simply cautious steps on our part, and we could be placing too much weight on the Diana survey results. The drawn-out nature of the Diana threat or statements by public officials might have led to the higher-than-normal shelter use rates, or we might be placing undue confidence in the data, considering the sample size. It's also possible, however, that demographic characteristics of the population-at-risk are conducive to shelter use.

Officials have estimated that 40,000 people used public shelters in the Grand Strand area during Diana. Using a figure of 200,000 as the population-at-risk, including low-risk areas, that would indicate that 20% of the total population, or roughly 40% of the evacuees went to shelters. Given the likelihood of double counting due to the fact that two evacuations occurred, that some of the shelters were out of the local area, that possibly a third of the vacationers in the area might have been using public shelters, and that both the 40,000 and 200,000 figures are rough estimates, we don't believe the data dictates a modification of the recommendations stated earlier. If more rigorous analysis of shelter use data confirmed the above statistics, then a reconsideration of our recommendations would be in order. If we wanted to be extremely cautious we would use 25% for the Myrtle Beach area and 30% for Georgetown.

4. Another factor to consider is the urgency of the evacuation. If a storm "turns" unexpectedly and a large number of people have to leave home shortly before landfall -- particularly a very severe storm -- shelter use will be higher than it otherwise would be. The late "turn" to the west after the stall might have caught some people off guard and led to the higher shelter uses in Diana, for example.

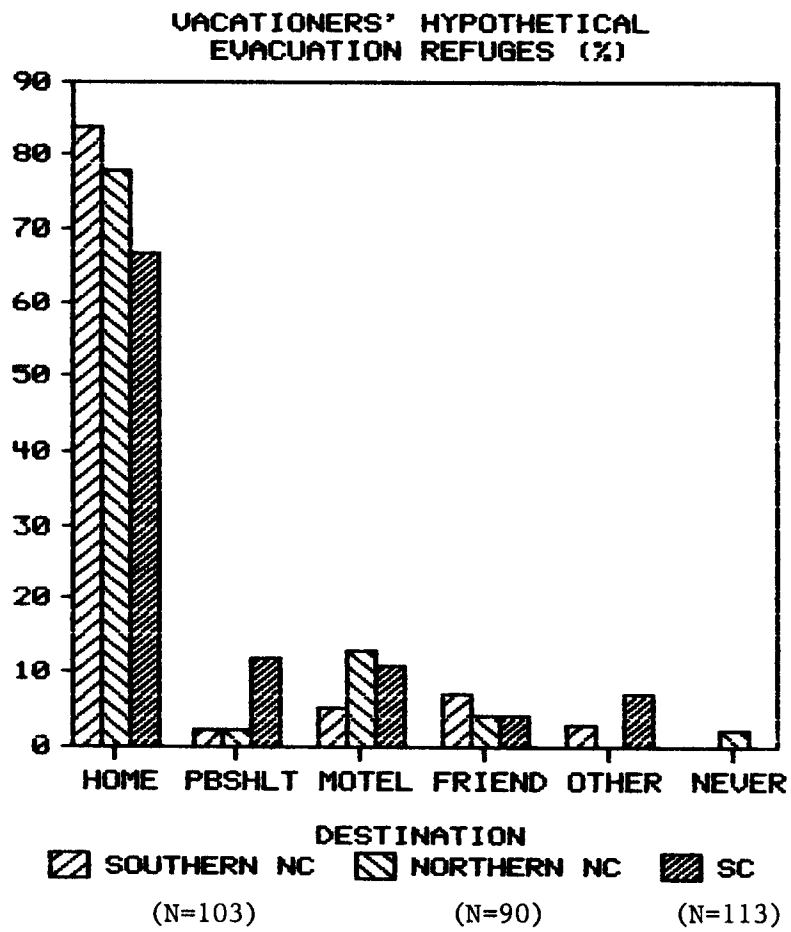
5. Finally, if you want shelter use to be higher, you can make it higher by aggressively publicizing locations and availability of shelters during the threat and by opening them early. We have also seen communities take just the opposite approach: not opening or announcing shelter locations until shortly before landfall. The reasoning was that if people didn't know they had shelters as an ace-in-the-hole, they would evacuate elsewhere early.

6. Motel use will usually be around 15% in the Myrtle Beach area, due to the availability of rooms in what many people might consider safe locations. In Georgetown motel use will be closer to 5%.

Vacationers

The majority of vacationers who evacuate will simply return home. In our hypothetical survey (Fig. 23) 67% of the Grand Strand vacationers said they would leave for home. Eleven percent said they would seek a public shelter, 10% would go to a hotel or motel, and about 4% would plan to stay

Figure 23



with friends. Expected use of public shelters was higher in South Carolina than in North Carolina, and fewer would plan to return home. These differences probably stem from the fact that a larger portion of the Grand Strand's vacationers come from long distances, thereby making an unplanned and possibly unnecessary trip home more disruptive. South Carolina vacationers were also more likely to have said they had given no thought to what they would do in a hurricane threat, however. The North Carolina survey responses are more consistent with results obtained in a similar survey of vacationers on St. George Island, Florida.

We are unaware of any reliable quantitative data on where vacationing evacuees have actually gone during a hurricane threat but responses from the 20 motel operators in our survey are interesting. Some operators reported that none of their evacuating guests went to public shelters, while others said that all of theirs did. Taken as a whole, and weighted by the size of the establishment, the operators indicated that 38% of their guests who left went to public shelters when they evacuated initially. We have no way of knowing how accurate these perceptions are. Nine of the 20 operators said that more than half of their evacuees returned and evacuated a second time, suggesting that they hadn't evacuated very far the first time. The operators indicated that when their guests left the second time, most went home. This tends to be confirmed by the fact that 13 out of 19 operators said that fewer than 25% of their original guests returned after the second evacuation. The seven campground operators we interviewed indicated that most of their campers went to public shelters and returned to evacuate a second time.

Conclusions

1. In the most likely threats, about 10% of the vacationers in the Grand Strand will seek refuge at public shelters. The great majority --70% to 80%-- will return to their homes.

2. A very late evacuation (as a result of a quickly turning or intensifying storm) could drive shelter use much higher, as vacationers simply don't have time to head for home. The motel operator interviews suggest that in an "iffy" evacuation like the initial Diana evacuation, significantly more than 10% might go to public shelters.

3. In most evacuations about 10% of vacationers will probably seek motel accommodations nearby but in safe locations. In an early, uncertain evacuation like Diana, this figure too could be higher. If they are unable to find such accommodations, some of those people will seek public shelter, but most will probably go home or go much further inland for accommodations.

4. We believe the people who are most likely to seek public shelter or motel accommodations are people who are more than, say, an 8 to 12 hour drive from their home. In specific locales which cater to such distant vacationers, note should be taken of this pattern.

DESTINATIONS AND ROUTES

Specific geographical locations of evacuation destinations are needed for route assignment in transportation modelling. The following discussion will address the destinations in fairly coarse form, but a complete inventory of every location mentioned in interviews will be submitted with the final report.

Residents

Surveys Following Diana

Figure 24 gives the percentage of evacuees in Diana who went out-of-town when they evacuated and the percentage who found refuge locally. Myrtle Beach evacuees were almost evenly divided between those who went to out-of-town locations and those who stayed in the local area. In southern North Carolina almost 60% of the mainland evacuees stayed locally, while only 30% of the beach residents did so. Of those Myrtle Beach residents who went out-of-town, about three-fourths went to South Carolina towns.

Roughly the same pattern was found when nonevacuees were asked where they would have gone if they had left. In both Myrtle Beach and Georgetown about 55% said they would have gone out-of-town.

Pre-Diana Hypothetical Responses

In interviews conducted before Diana 90% of the Myrtle Beach respondents and 95% of the Georgetown respondents said they would go to South Carolina locations (Figure 25). Again, the local vs. out-of-town proportions were approximately the same.

Actual Responses in Other Locations

The Carla evacuation in Texas demonstrates how widely local vs. out-of-town rates can vary from place-to-place in the same storm. Cameron Parish, Louisiana had virtually no safe refuge locations within the parish and Calhoun County was the area in Texas where Carla made landfall and is low-lying over a large area. Consequently, over 90% of the evacuees in both areas went out-of-town. In other locations surveyed 45% to 55% went out-of-town. In Frederic between 60% and 80% went out-of-town in four communities surveyed (Grand Isle, La.; Pass Christian, Miss.; Pensacola, Fl.; Panama City Beach, Fl.). In Allen 85% of Galveston's evacuees went out-of-town, but in Alicia only 50% did. Allen was an extremely severe storm when the evacuation was taking place, and the evacuation was very early, with officials recommending that residents take a "long weekend" off work and go inland to visit someone. Alicia was a fairly weak storm when most of the evacuation took place, and alarm wasn't raised until too late for most people to attempt a long evacuation. In Camille only about 20% of the evacuees went out-of-town, which is the mirror image of the fact that so many people went to local shelters.

Figure 24

LOCATION OF REFUGE IN DIANA (%)

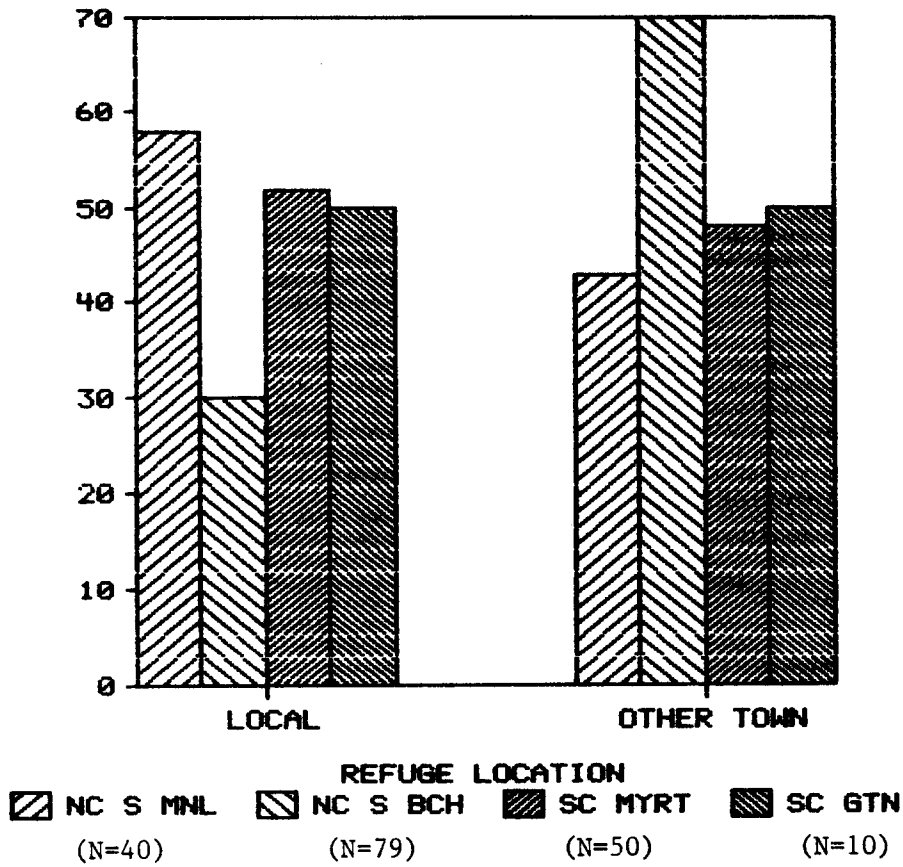
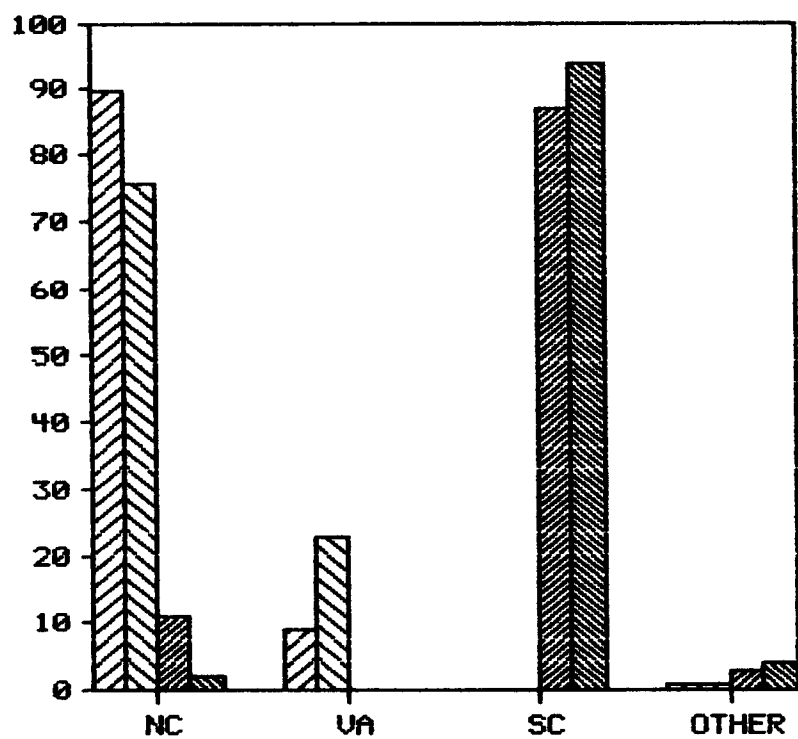


Figure 25

HYPOTHETICAL STATE DESTINATIONS (%)



/ NC N MNL (N=86) / NC N BCH (N=75) / SC MYRT (N=91) / SC GTN (N=99)

Conclusions

1. In most locations evacuees who don't go to public shelters are most likely to go out-of-town by a wide margin. In general, the rate of going out-of-town will increase with the severity of the storm, the earliness of the evacuation, the lack of safe refuge nearby in the community, and the income of the evacuees.

2. Residents of high-risk areas are more likely to go out-of-town than residents of low-risk areas. This is the mirror image of the public shelter use conclusion, and in projecting out-of-town evacuation response, the two sets of conclusions should be considered together.

3. For planning purposes we would use an assumption of 50% going out-of-town in most evacuations. In a slow moving, severe storm in which public officials urge early evacuation, 70% could easily go out-of-town. In a weak or late-turning storm, less than 50% might go out-of-town.

4. Detailed listings of destinations will give a general impression of the spatial distribution of where out-of-town evacuees will go but are not statistically useful estimates for each destination.

Vacationers

As we noted earlier the majority of vacationers say they would return home when they evacuated in a hurricane threat. Up to 20% to 25% might seek motels, friends, or possibly public shelters locally or nearby. The destinations of those who would go home would correspond to the states listed in Table 1 in our discussion of evacuation rates among vacationers.

Ten of the 19 motel operators and all seven of the campground operators in our survey indicated that over half of their evacuating guests returned after the first evacuation. This suggests that those people went to local or nearby inland locations such as Florence in the case of many campers. Thus in at least some evacuations --probably ones in which the perceived advisability of evacuating is highly uncertain-- 25% to 50% of vacationers might not return home.

VEHICLE USE

Vehicle use is necessary for transportation modelling in three primary ways. Estimates are needed of the number of total vehicles which will be on the evacuation routes, rather than simply the number of evacuees. This section provides a number of vehicles per evacuating household. Estimates of the number of motorhomes are needed because they pose special traffic flow and safety problems. Estimates of the number of trailers are needed for the same reasons.

Residents

Surveys Following Diana

Figure 26 shows the percentage of evacuees who used various numbers of cars and trucks in evacuating during Diana, and Figure 27 shows the number of such vehicles available in the households. Most evacuating parties used only one vehicle, and not all available vehicles were taken. None of the evacuees said they drove motorhomes or pulled trailers. In North Carolina, however, 3% of both the mainland and beach samples took motorhomes and another 3% pulled trailers.

Pre-Diana Hypothetical Responses

Figures 28 and 29 depict the numbers of vehicles area residents said in interviews before Diana they would take and the numbers available respectively. The patterns are similar to those observed in Diana, at least in the Myrtle Beach area. In the hypothetical surveys, however, 6% and 4% of the Myrtle Beach and Georgetown samples respectively thought they might take motorhomes. One percent in both locations thought they might pull trailers.

Hypothetical Responses from Other Areas

Surveys in other areas have yielded vehicle use figures which are quite comparable to those found in South Carolina. Most respondents indicate that about 70% to 75% of the available vehicles in the household would be used in an evacuation. Some locations report higher trailer and motorhome use than found in South Carolina, but one would expect that phenomenon to be highly localized.

We are unaware of any actual use data other than from Diana.

Conclusions

1. We would use a figure of about 70% to 75% of available vehicles being used. The figure appears quite uniform over locations.
2. Care should be taken to assess whether some locations have an unusual number of motorhomes and trailers registered. While not a major problem overall, they could be locally. In one Florida site 31% of the respondents said they would be pulling trailers.

Figure 26

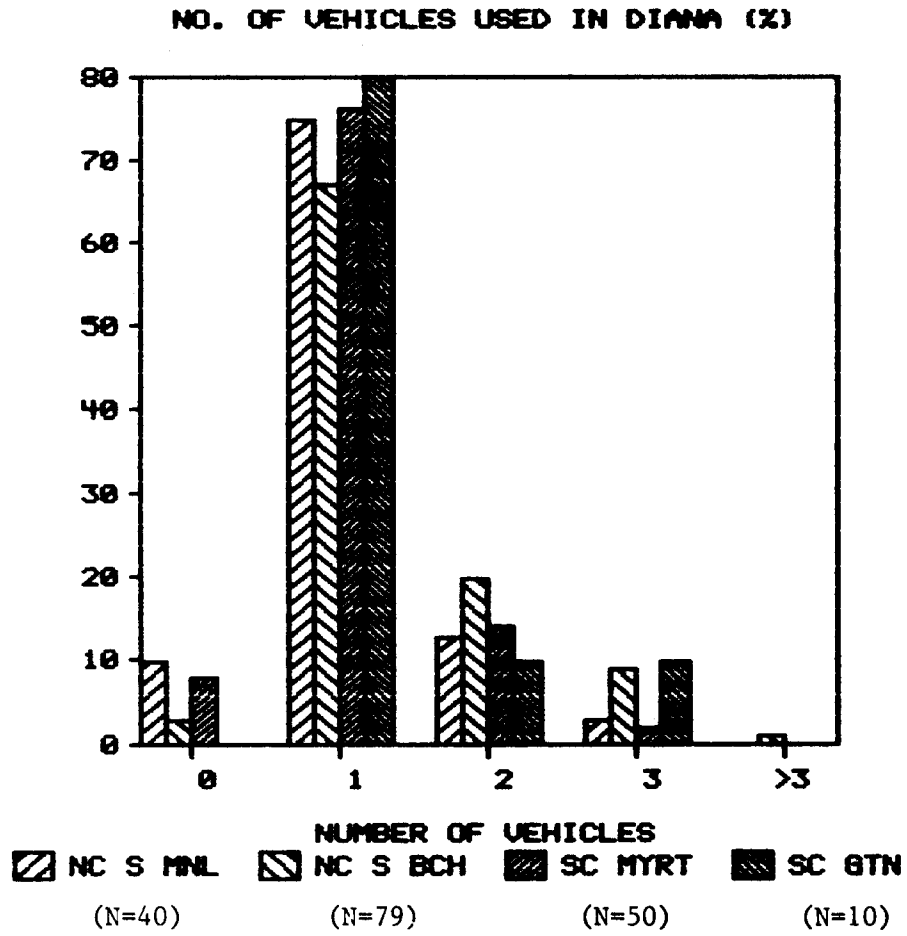


Figure 27

AVAILABLE VEHICLES IN DIANA
WARNING AREA (%)

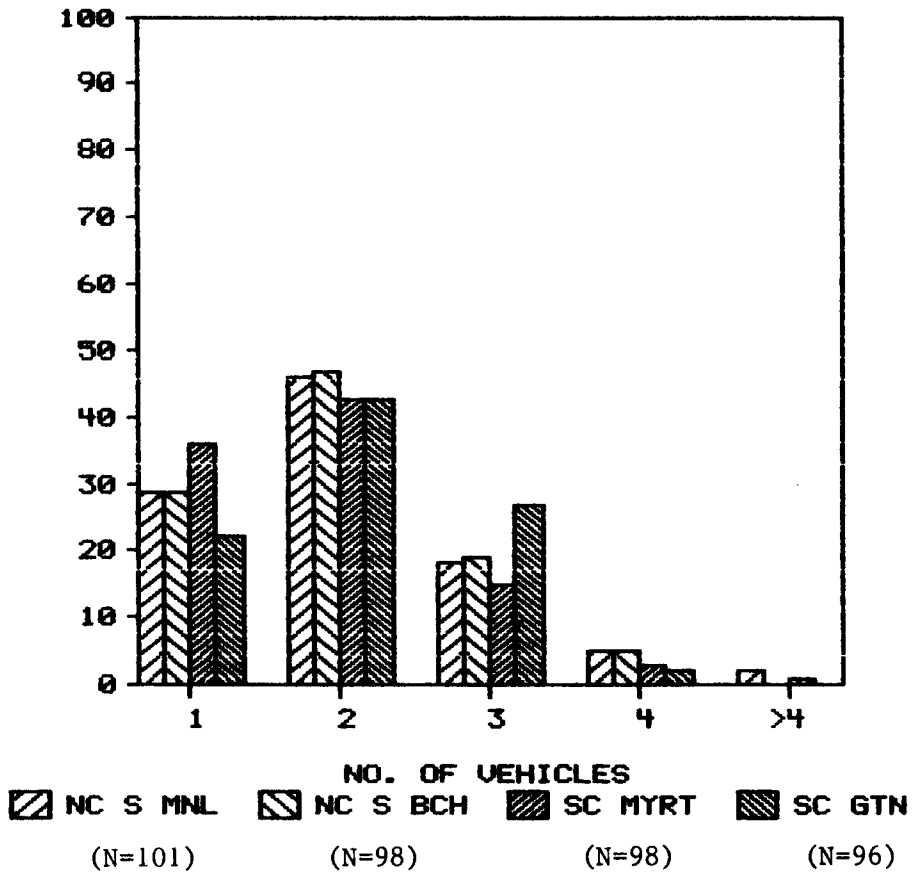


Figure 28

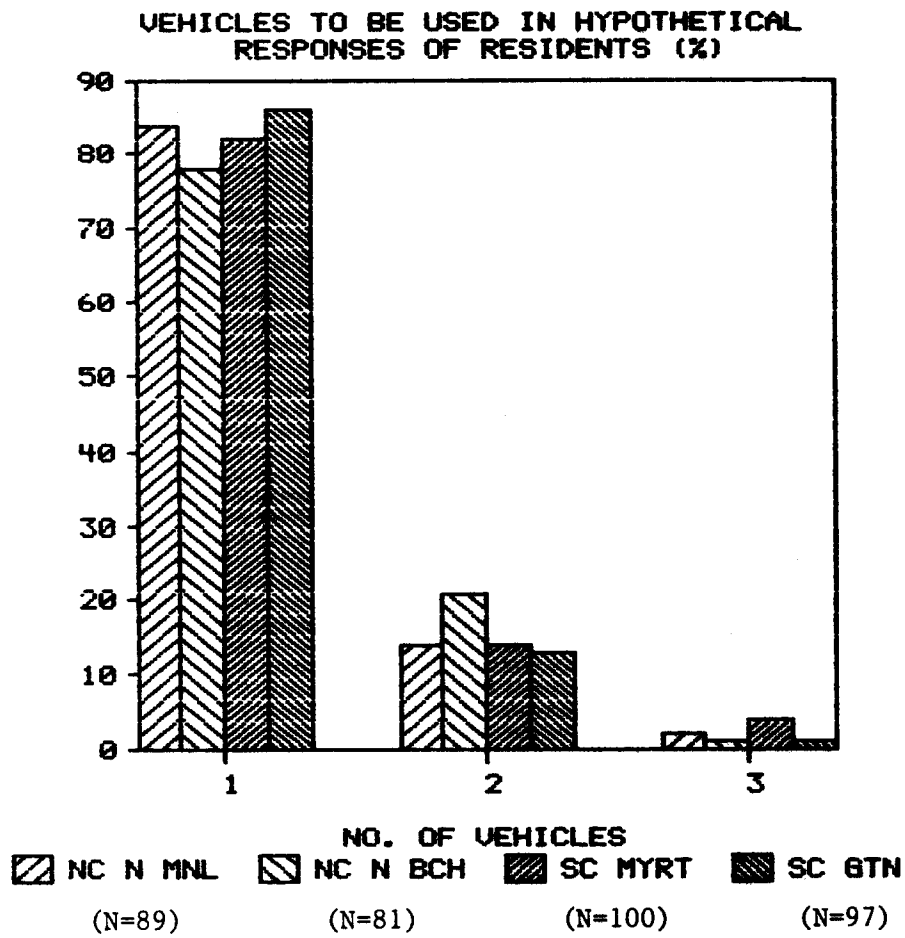
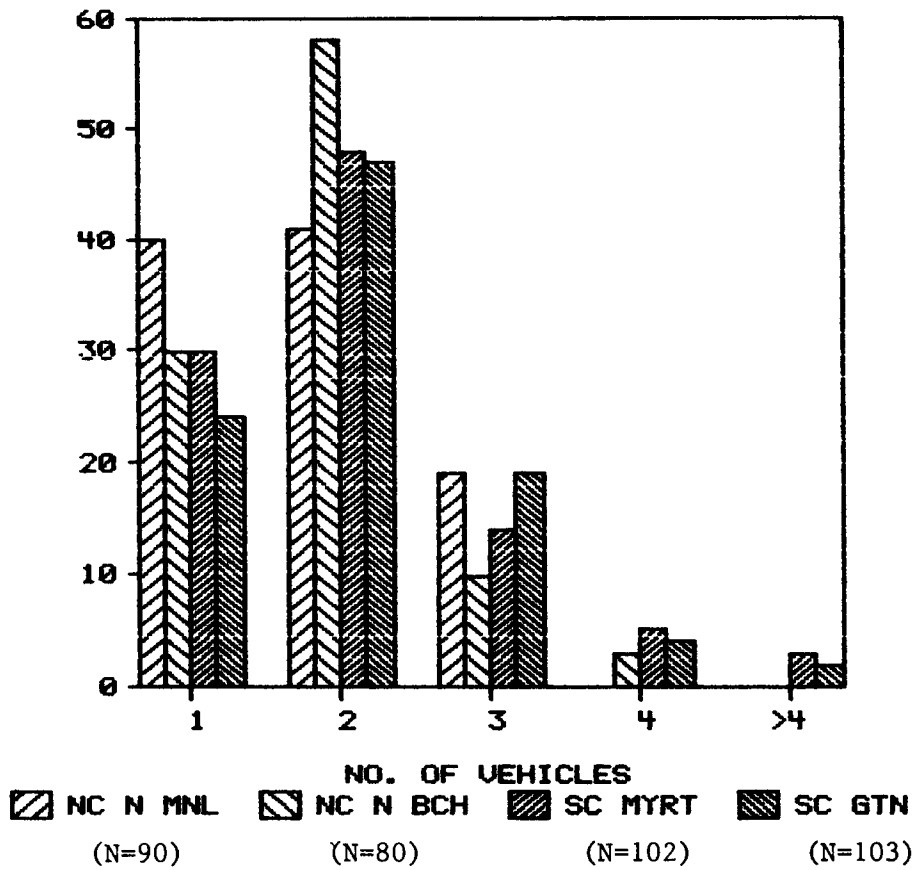


Figure 29

VEHICLES AVAILABLE TO HYPOTHETICALS (%)



Vacationers

Almost all the South Carolina vacationers drive to where they stay and will have a car or truck available for their evacuation. Of the seven campground operators we interviewed, two said that only 5-10% of their guests took their trailers when they evacuated, four said that about half took theirs, and one said that almost all took theirs. These variations do not appear related to hazardousness of the campground locations or size of the campground. Actions by the operators themselves are a possible explanation. Almost all the operators said that many people who had their campers stored onsite phoned to inquire about what they should do, but only one operator indicated that "several" owners came to remove their campers.

GRAND STRAND HYPOTHETICAL DESTINATIONS

<u>Destinations</u>	<u>Frequency</u>
Conway	16
N. Myrtle	14
Florence	13
Grand Strand	10
Don't Know	6
Columbia	4
Charlotte, NC	3
Dillon	3
Bennetsville	2
Marion	2
Andrews	1
Ashville, NC	1
Aynor	1
Barnwell	1
Briarcliffe	1
Clarkton	1
Dennisville	1
Gatlinburg, TN	1
Georgetown	1
Greensboro, NC	1
Greenville	1
Kingston	1
Lake City	1
Litchfield	1
Loris	1
Macon, GA	1
Myrtle Is.	1
New London, CT	1
Nichol	1
Orangeburg	1
Socetee	1
Sumter	1
Turbeyville	1
Vero Beach, FL	1
Wake Court	1
Wakisaw	1
Wampec	1
Whitesville	1
Wilkesboro	1
Wilmington, NC	1
Winnsboro	1

GEORGETOWN HYPOTHETICAL DESTINATIONS

<u>Destinations</u>	<u>Frequency</u>
Georgetown	58
Columbia	10
Andrews	9
Augusta	3
"Inland"	3
Conway	2
Florence	2
Anderson	1
Browning Ferry	1
Charlotte, NC	1
Darlington	1
Denmark (SC)	1
Greenville	1
Hartsfield	1
Hemingway	1
Kinston	1
Kingstree	1
Lumberton	1
Marion	1
Orangeburg	1
Plantersville	1
So. Myrtle Beach	1
Spartanburg	1
Sumter	1

GRAND STRAND DESTINATIONS IN DIANA

<u>Destination</u>	<u>Frequency</u>
Dillon	3
Florence	2
Charlotte, NC	2
Conway	2
Marion	2
Anderson	1
Bennisville	1
Camden	1
Charlottesville, VA	1
Columbia	1
Fapit	1
Georgetown	1
Greensboro, NC	1
Lumberton, NC	1
Maryville	1
Marsheille, NC	1
Pauleys Island	1
Tuberville	1

HURRICANE DIANA PUBLIC RESPONSE QUESTIONNAIRE

Hello. My name is _____. I'm helping do a survey for the Corps of Engineers asking people some questions about their reactions to hurricane Diana. The Corps was already in the process of doing a hurricane evacuation study for this area when Diana hit, and your answers to these questions will help tremendously with that study. Can you take a few minutes to help us please?

1. Were you here in the area (i.e., not out-of-town) when Diana began to threaten this area?

IF NO, ASK IF ANYONE ELSE IN THE HOUSEHOLD WAS PRESENT AND ASK TO SPEAK TO THEM. IF NO ONE IN THE HOUSEHOLD WAS PRESENT, TERMINATE INTERVIEW.

IF YES, GO TO QUESTION 2.

2. Did you leave your home to go someplace safer before the hurricane?

Yes _____ (GO TO Q. 3)

No _____ (GO TO Q. 14)

Other: _____
(Specify)

3. Did you go to a

Public Shelter _____

Friend's or Relative's _____

Hotel/Motel _____

Other: _____
(Specify)

4. Where was that located?

Locally _____

Out-of-town: _____
(Specify)

Route(s) Used: _____

- 4a. How many of the following types of vehicles did your household take in the evacuation?

Cars/Trucks: _____ Motorhomes: _____ Trailers: _____

5. What convinced you to go someplace safer?

	Reason 1	Reason 2	Reason 3
Advice or Order from Public Officials	_____	_____	_____
Advice or Order from Civil Defense	_____	_____	_____
Advice from Weather Service	_____	_____	_____
Advice / order from police or firemen	_____	_____	_____
Advice from media	_____	_____	_____
Advice from friend/relative	_____	_____	_____
Concern about severity of storm	_____	_____	_____
Concern that storm <u>would</u> hit	_____	_____	_____
Concern that storm <u>might</u> hit	_____	_____	_____
Heard probability (odds) of hit	_____	_____	_____
Other: _____			
(Specify)			

6. Just to refresh your memory, Diana hit around 2 AM Thursday, September 13th, after stalling just offshore Tuesday night. When did you leave your home to go someplace safer?

_____ (hour, using 2400 clock) _____ (date)

7. How long did it take you to get to where you were going?

_____ Hrs (to nearest 1/2 hr)

Never reached original destination _____

8. Did you have any difficulty getting there?

Traffic heavy _____

Weather bad _____

Couldn't find shelter _____

Other: _____

Tuesday _____ \$ > GO TO Q. 10
Wednesday _____ /
Thursday _____ \$
Friday _____ \$ > GO TO Q. 17
Later _____ /

Reason <u>1</u>	Reason <u>2</u>	Reason <u>3</u>
--------------------	--------------------	--------------------

11. Did you stay at home then or did you leave again before the storm hit?

12. When did you leave?

13. Where did you go?

Other: _____
(Specify)

14. What made you decide not to go anyplace else?

	Reason <u>1</u>	Reason <u>2</u>	Reason <u>3</u>
Storm not severe/house adequate	_____	_____	_____
Waited too late to leave	_____	_____	_____
Didn't know there was a storm	_____	_____	_____
Officials said evacuation unnecessary	_____	_____	_____
Weather Service said evacuation unnecessary	_____	_____	_____
Media said evacuation unnecessary	_____	_____	_____
Friend/relative said evacuation unnecessary	_____	_____	_____
Other sources said evacuation unnecessary	_____	_____	_____
Probabilities indicated low chance of hit	_____	_____	_____
Storm track predicted to hit elsewhere	_____	_____	_____
Other information indicated storm wouldn't hit	_____	_____	_____
No one said to evacuate	_____	_____	_____
Had no transportation	_____	_____	_____
Had no place to go	_____	_____	_____
Wanted to protect against looters	_____	_____	_____
Wanted to protect against storm	_____	_____	_____
Left unnecessarily in past	_____	_____	_____
Job required staying	_____	_____	_____
Other: _____			

(Specify)

15. IF you had left home to go some place safer, would you have gone to a

Public Shelter _____

Friend's or Relative's _____

Hotel/Motel _____

Other: _____
(Specify)

16. Where would that have been located?

Locally _____

Out-of-town: _____

17. Did you hear from anyone in an official position -- civil defense, the mayor's office, the governor, police -- that you should evacuate to a safer place?

	<u>1st</u>	<u>2nd</u>	<u>3rd</u>	
No _____				GO TO Q. 19
Yes, governor	_____	_____	_____	¢
Yes, civil defense	_____	_____	_____	¢
Yes, police/sheriff	_____	_____	_____	>
Yes, other: _____				Q. 18
Don't Know _____				

18. Did they say that you should evacuate or that you must evacuate?

Should _____ Must _____ Don't Know _____

19. Did you hear from anyone else that you should evacuate?

	<u>1st</u>	<u>2nd</u>	<u>3rd</u>
No _____			
Yes, friend/relative	_____	_____	_____
Yes, media	_____	_____	_____
Yes, Weather Service	_____	_____	_____
Yes, Other: _____			
Don't Know _____			

20. Did you ever hear or see any information giving the chance -- it might have been called "odds" or "probability" -- that Diana would hit this area? For instance, that there was a certain "percent chance" of it hitting here?

No _____ \$ > GO TO Q. 23
Don't Remember _____ /
Yes _____ GO TO Q. 21

21. Did you understand what the numbers meant?

Yes _____
Yes, pretty well _____
No _____
Not sure _____

Other: _____

22. Do you think it's useful to you to have the probability information in helping you decide what to do when there's a hurricane threat?

Yes _____
Maybe _____
No _____
Don't know _____

Other: _____

23. How well do you think the warning and evacuation process was handled in Diana?

Extremely well _____
Pretty well _____
Traffic a problem _____
Not enough information _____
Told to evacuate too early _____

Other: _____

24. Do you have any suggestions for how the process could be improved?

25. Would you do anything differently in the same situation again?

Would evacuate	_____
Wouldn't evacuate	_____
Would leave earlier	_____
Would wait later to leave	_____
Would go further away	_____
Wouldn't go as far	_____
Would go to public shelter	_____
Wouldn't go to public shelter	_____

26. That's all of our hurricane Diana questions. Now we have just a couple of background questions. First of all, how old were you on your last birthday?

_____ Years

27. How many people live in your household?

28. How many vehicles do you have?

29. Is there anything at all that you would like to add about the Diana threat and the evacuation?

1. _____
2. _____
3. _____

SOUTH CAROLINA RESIDENT QUESTIONNAIRE
(Hypothetical)

Interviewer _____ Location _____

Date _____

Respondent _____

Hello. I'm helping conduct a study of hurricane evacuation. We're interested in knowing where you would evacuate to, how you'd get there, and under what conditions you would leave during a hurricane threat.

1. First of all, do you live here year-round?

_____ Yes (GO TO Q. 2)

_____ No

IF NO:

Are you usually here during the summer?

_____ Yes

_____ No

2. Let's suppose there's a pretty bad hurricane out there in the Atlantic--say, a Category 3, a dangerous storm--and it looks like it could hit this area. The National Hurricane Center has issued a hurricane watch for this area--that means the storm probably won't hit for at least 24 hours, but low places in roads could be flooded sooner than that well before the worst of the hurricane arrived. Local officials haven't advised any specific actions yet.

I know you can't say for sure what you would do in that situation, but do you think you and the rest of the people living with you would evacuate under those circumstances? (When I say evacuate I mean going someplace else that you think would be safe if the hurricane hit; it could be nearby or far away.)

_____ Yes, all in household would leave or probably would

_____ Some would leave then, others wouldn't

_____ Don't know, maybe

_____ No, wouldn't leave then

_____ Other _____

IF RESPONDENT SAID YES TO 2, GO TO 3A; OTHERWISE GO TO 3:

3. Okay. Let's suppose the storm is a lot closer now. The Hurricane Center has issued a warning for this area, and local officials have ordered an evacuation. For the sake of argument, let's suppose you and your household decided to evacuate.
- 3A. Where do you think you would go? First I want to know the type of place you'd go: a public shelter, a friend's or relative's, a motel, or someplace else.

IF PART OF HOUSEHOLD WOULD GO ONE PLACE AND PART ANOTHER PLACE,
DESCRIBE PARTIES (1 AND 2) AND RECORD 2 SETS OF ANSWERS

PARTY 1 (_____) PARTY 2 (_____)

_____ Home

_____ Home

_____ Public Shelter

_____ Public Shelter

_____ Friend's/Relative's

_____ Friend's/Relative's

_____ Motel

_____ Motel

Other _____

Other _____

_____ Wouldn't go at all

_____ Wouldn't go at all

4. Where would that be--what city or town?

5. What route would you take to get there?
(What roads, through what towns?)

6. How many people would probably be in your group(s)?

7. How many cars or other vehicles do you have at your household?

8. How many of them would you be taking when you evacuated?/
/Would you be taking it when you evacuated?

9. Would you be pulling a trailer of any kind--boat, camper, etc.?

_____ Yes

_____ Yes

_____ No

_____ No

_____ Don't Know

_____ Don't Know

10. Would you be taking a motorhome?

_____ Yes

_____ Yes

_____ No

_____ No

IF "PUBLIC SHELTER" OR "MOTEL" IN Q. 3, GO TO 11; OTHERWISE GO TO 12.

11. A few minutes ago, you said you would probably go to a public shelter/
motel when you evacuated.

Do you have friends or relatives either locally or further away where
you could go and feel safe if a hurricane were threatening?

_____ Yes

_____ No (GO TO Q. 12)

_____ Maybe/Depends

_____ Other

IF YES OR MAYBE:

11a. Do you think you might go there rather than to a public shelter or
motel?

_____ Yes

_____ Maybe/Depends

_____ No

(EXPLAIN)

IF YES OR MAYBE

11b. Where do they live?

12. Have you ever been in this area before during a hurricane threat?

_____ Yes

_____ No

IF YES TO Q. 12, GO TO 13; IF NO, GO TO CLOSE.

13. Which hurricane(s)?

14. What did you do then?

<u>HURRICANE 1</u>	<u>HURRICANE 2</u>	<u>HURRICANE 3</u>
_____ (Name)	_____ (Name)	_____ (Name)
____ Stayed	____ Stayed	____ Stayed
Evacuated to:	Evacuated to:	Evacuated to:
____ Public Shelter	____ Public Shelter	____ Public Shelter
____ Friend/Relative's	____ Friend/Relative's	____ Friend/Relative's
____ Motel	____ Motel	____ Motel
____ Other	____ Other	____ Other
***	***	***
____ Locally	____ Locally	____ Locally
____ Out-of-town to:	____ Out-of-town to:	____ Out-of-town to:
_____ (Name)	_____ (Name)	_____ (Name)

CLOSE

Thank you very much for your help. Do you have anything else you'd like to add that we haven't asked about?

Thanks again. Goodbye.

VACATIONER QUESTIONNAIRE

Hello. My name is _____, and I'm helping do a study to be used by local agencies in hurricane preparedness planning. We're trying to learn what visitors would plan to do if a hurricane threatened this area and what could be done to help ensure your safety without disrupting your visit any more than necessary. Please understand that there is no hurricane threatening the area at this time. This is just a general purpose study.

1. First of all, where are you from?

_____, _____
(City) (State)

IF LOCAL, TERMINATE INTERVIEW.

2. How many people are in your party?

3. How did you get here?

Flew, commercial air _____
Flew, private plane _____
Drove _____
Bus tour _____

Other _____
(Specify)

IF OTHER THAN "DROVE" IN Q. 3, GO TO Q. 3A, OTHERWISE GO TO Q. 4:

- 3A. Do you have a car here? (e.g., rental car)

Yes _____
No _____

Other _____
(Specify)

4. How long a stay do you have planned? That is, how long will your total visit be?

_____ Days

5. How long do you have left?

_____ Days

6. At the end of your stay here do you plan to return home or continue your vacation someplace else?

Return home _____
Go someplace else _____

Other _____

7. Did you have to pay in advance for your stay here?

One night deposit only _____
Yes, full amount _____
No _____

Other _____

8. Have you given much thought to what you would do if a hurricane threatened this area while you were here?

Yes _____
A little _____
No _____

Other _____

9. Do you think this location, where you're staying, would be safe in a hurricane?

Yes _____
No _____
Depends on Storm _____
Don't Know _____

Other _____

10. Suppose there was a relatively minor hurricane in the Atlantic--what they call a Category 1 or 2 storm with winds around 90 or 95 mph. There's been a hurricane watch issued from Savannah to Cape Hatteras, but local officials here haven't said anything yet about whether people should evacuate, and the weather is still good at the time.

What do you think you would do?

- a. Pack up and leave for another vacation area _____
b. Pack up and leave for home _____
c. Pack up and go short distance away to safe motel or someplace else so could return if storm missed _____
d. Check with management for advice _____
e. Wait for additional information, order, or for weather to worsen _____

f. Other _____

(Specify)

IF WOULDN'T LEAVE IN Q. 10, GO TO Q. 11; OTHERWISE GO TO 13.

11. What if the weather was rainy and windy and expected to stay that way for a couple of days even if the storm missed?

Would you do anything differently?

No _____

Yes, more likely to leave _____

Other _____

IF NO TO Q. 11, GO TO Q. 12; OTHERWISE GO TO Q. 13:

12. What if it was a worse storm, say the winds were up to 115 or 120 mph, and the National Hurricane Center had issued a hurricane warning rather than just a watch for this area. The weather is windy and rainy, local officials have advised people to evacuate the area.

What would you do in that case?

- a. Pack up and leave for another vacation area _____
- b. Pack up and leave for home _____
- c. Pack up and go short distance away to safe motel or
someplace else so could return if storm missed _____
- d. Check with management for advice _____
- e. Wait for additional information, order, or for
weather to worsen _____

f. Other _____

13. Where would you go if you evacuated?

First of all, to what type of place would you go? (Read first four.)

Home _____

Public Shelter _____

Hotel/Motel _____

Friend/Relative _____

Wouldn't go _____

Other _____

14. What city or town would that be in?

(City, State)

15. How would you get there? That is, what route would you take?

(Route No.'s or Towns Passed Through)

16. Do you think this motel/hotel would refund the balance of your advance payment if you evacuated ?

Yes _____
No _____
Don't Know _____

Other _____

17. What if the balance would not be refunded? Would that keep you from evacuating in the situations I described earlier?

No _____
Yes _____
Don't Know _____

Other _____

18. Have you ever been here on vacation in the past when there was a hurricane threat?

Yes _____
No _____

Other _____

IF YES TO Q. 18, GO TO Q. 19; OTHERWISE GO TO Q. 21:

19. What storm was that?

David, 1979 _____

Other _____

20. What did you do in that storm threat?

a. Evacuated to home _____
b. Evacuated to other vacation location _____
c. Evacuated to friend/relative nearby _____
d. Evacuated to friend/relative inland _____
e. Evacuated to local public shelter _____
f. Evacuated to inland public shelter _____
g. Didn't evacuate _____

h. Other _____

21. Are you here with friends or with family?

Friends _____
Family _____
Both _____

22. How old are you?

Under 21 _____
21 to 40 _____
40 to 60 _____
60 or over _____

CLOSE: THANK YOU VERY MUCH FOR YOUR TIME. HAVE A NICE VISIT.

SOUTH CAROLINA CAMPGROUND QUESTIONS

1. About what percent of your campers left during the Diana threat?

_____ %

2. Of those who left, roughly what percent left on which day?
(Most people left the Myrtle Beach area on Tuesday, September 11. Diana stalled that night and came ashore around 2am on Thursday the 13th.)

Monday, 10th _____ %

Tuesday, 11th _____ %

Wednesday, 12th _____ %

Thursday, 13th _____ %

3. Of those who left, what percent took their trailers?

_____ %

4. Where did most of them go?

Local public shelters _____ %

Inland nearby _____ %

Locally to friends' _____ %

Locally to other places _____ %

Home _____ %

Other _____ %

5. How many (what %) returned early, then left a second time?

6. Did any people who leave their trailers with you year-round come and remove them before the storm?

_____ No, few even phoned

_____ No, but many phoned

_____ Yes: _____
(How many?)

7. About how many campsites do you have?

8. How close to the ocean is your campground?

☐ Adjacent to the ocean

☐ East of King's Highway (Hiway 17)

☐ East of intracoastal waterway, west of King's Hiway

☐ Other

9. Is there anything else you can think of that we should know about how the campers reacted to Diana or how they might react to another storm in the future?

HOTEL/MOTEL QUESTIONS
REGARDING HURRICANE DIANA

1. How close to the ocean is your business?

- ☐ Adjacent to ocean
- ☐ Within a block of the ocean
- ☐ East of King's Highway
- ☐ East of intracoastal waterway
- ☐ West of intracoastal waterway
- ☐ Other

2. Was your business in an area where public officials advised or ordered people to evacuate?

- ☐ Yes
- ☐ No
- ☐ Not sure

3. About what percent of your guests left the hotel/motel to go someplace safer during the Diana threat?

- | | |
|--|-------------------------------------|
| <input type="checkbox"/> Less Than 25% | <input type="checkbox"/> 75% to 95% |
| <input type="checkbox"/> 25% to 50% | <input type="checkbox"/> Over 95% |
| <input type="checkbox"/> 50% to 75% | |

4. Of those who left, roughly what percent left on which day? (Most people left the Myrtle Beach area on Tuesday, September 11. Diana stalled that night and came ashore around 2 am on Thursday the 13th.)

Monday, 10th	<input type="text"/> %	Wednesday, 12th	<input type="text"/> %
Tuesday, 11th	<input type="text"/> %	Thursday, 13th	<input type="text"/> %

5. Of those who left early, how many (what percent) returned and had to leave a second time?

- | | |
|--|-------------------------------------|
| <input type="checkbox"/> Less than 25% | <input type="checkbox"/> 75% to 95% |
| <input type="checkbox"/> 25% to 50% | <input type="checkbox"/> Over 95% |
| <input type="checkbox"/> 50% to 75% | |

6. As best you can, please indicate the percent who went to various places.

First Time	Second Time (If Applicable)
<input type="text"/> % Local Public Shelters	<input type="text"/> % Local Public Shelters
<input type="text"/> % Inland Nearby	<input type="text"/> % Inland Nearby
<input type="text"/> % Locally to Friends'	<input type="text"/> % Locally to Friends'
<input type="text"/> % Locally to Other Places	<input type="text"/> % Locally to Other Places
<input type="text"/> % Home	<input type="text"/> % Home
<input type="text"/> % Other	<input type="text"/> % Other

7. After the threat was finally over, about what percent of your original guests returned?

☐ Less than 25%

☐ 75% to 95%

☐ 25% to 50%

☐ over 95%

☐ 50% to 75%

8. What about people who had reservations but weren't present at the start of the threat. Please check all responses that apply.

☐ Most phoned to see whether they should cancel

☐ Most cancelled

☐ Some showed up during the threat, unaware of the threat

☐ Most delayed arrival but kept their reservations

9. Other comments:

BEHAVIORAL ANALYSIS

LOWER COAST REGION METHODS

The Model of Past Experience

The most reliable behavioral forecasts concerning how the public will respond to hurricane threats are made by examining the patterns of past hurricane response, including the reasons for variations in responses from place to place and storm to storm. To this end Hazards Management Group has developed a national model for predicting most public responses. A diagram of the model appears in Figure 1. The model is based upon carefully and systematically documented studies of how the public has responded in approximately 18 past hurricane threats dating to Carla in 1961. To use the model, we specify conditions and predict to those conditions. For example, to predict the portion of a population that will evacuate we need to specify the hazardousness of their location, the actions which will be taken by public officials, the severity of the storm, and so forth.

A common response to application of our model is "but our people are different." The database upon which the model is constructed includes threats in Texas, Louisiana, Mississippi, Alabama, several areas of Florida, South Carolina, and North Carolina, and there is tremendous cultural variety among the study locations. The studies measure characteristics of the people responding to the threat, and those attributes become part of the model when they are seen to affect response. Thus, the model is not place-specific in that local characteristics can be enumerated and taken into account. The truth is, however, that the sorts of factors (experience, etc.) which are commonly believed to affect response are not nearly so important as one might suppose.

Hypothetical Threat Responses

Nevertheless, there are occasional unusual circumstances which the model might not address adequately, and the model's database is stronger with respect to some sets of circumstances than others. To address those realities we conducted interviews with residents of selected locations in the study area. In Charleston 150 telephone interviews were completed. Roughly half were west of the Ashley River and half on the peninsula. One hundred residents in the city of Beaufort were interviewed by phone, and 148 St. Helena Is. residents were interviewed door-to-door.

The Charleston and Beaufort locations were chosen because they both include moderate- to low-risk areas, and the database of past response studies is not as large for such zones as for high-risk areas like barrier islands. St. Helena Is. was included because of concerns that it might be one of those unusual locations to which the model could have limited application.

Strictly from the standpoint of statistical reliability, the samples in all three locations are of reasonable size. For St. Helena and Charleston the samples of roughly 150 should yield estimates which one can be 90% "sure" are correct within 4 to 7 percentage points.

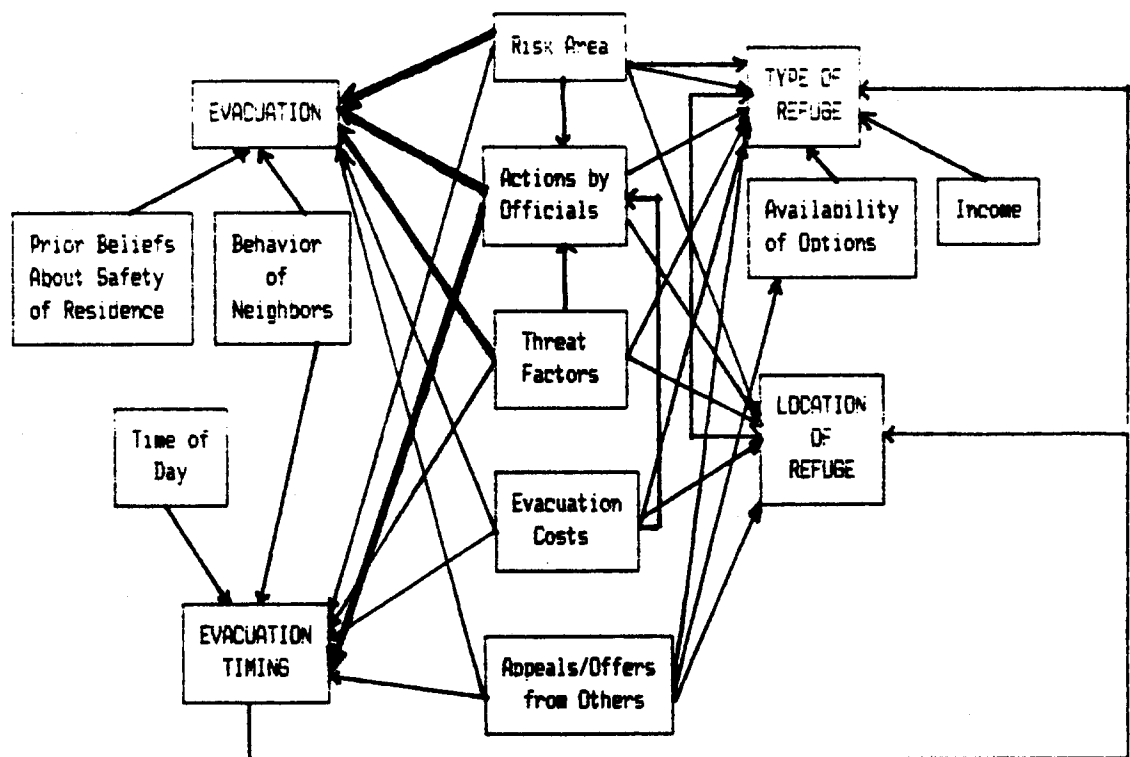


Figure 1

Hurricane Evacuation Behavior Model

In the Beaufort sample of 100 the estimates should have a 90% probability of accuracy within 5 to 8 percentage points. If the Charleston sample is disaggregated into halves (west of the Ashley and on the peninsula) the estimates for each should have a 90% chance of accuracy within 6 to 10 percentage points.

The accuracy levels for the South Carolina surveys might not be as high as one would demand if greater reliance was going to be placed upon the figures in projecting behavioral responses. In our use of the numbers we compare them to hypothetical survey results obtained in other locations having similar characteristics. We know the error factors normally inherent in hypothetical survey data concerning hurricane response and can therefore note whether residents in South Carolina survey sites fit the patterns observed elsewhere. If not, we adjust our application of the behavioral model accordingly. Hypothetical survey data alone is next to useless in predicting how people will respond to hurricane threats. Experience has demonstrated repeatedly that people don't usually do what they think they would do in such situations.

We will address five types of behaviors for both residents and vacationers:

1. Whether the population will evacuate
2. How quickly evacuees will leave
3. What sorts of refuges evacuees will seek
4. Whether evacuees will go out-of-town
5. How many vehicles will be taken by evacuees.

EVACUATION RATES

Residents

One of the most important factors affecting whether people evacuate in a hurricane threat is their perceived risk. If a person believes he is in a dangerous location, particularly with respect to storm surge, he is more likely to evacuate than not. Figure 2 indicates how survey respondents in the study area perceived the elevations of their homes. Very few people in any of the areas believe they are above 20 feet, and only on St. Helena do a majority believe they are above 10 feet. A third or more wouldn't even venture a guess in most locations. The significance of the data is that few people have a false sense of security regarding the vulnerability of their residences to flooding, and successfully disseminated evacuation notices should be very effective. If there is a misconception regarding hazardousness it might be that some residents believe they are more vulnerable than they actually are and will evacuate from relatively safe locations.

Interviewees were asked where they would evacuate in a major storm, and Figure 3 depicts the percentages who insisted they would not evacuate even if advised by public officials. Only on St. Helena did as many as 11% say they would stay. Figure 3 also indicates results from comparable surveys in Georgetown, Myrtle Beach, and locations outside South Carolina. The percentages indicating they wouldn't evacuate from Charleston and Beaufort were slightly lower than one finds in most survey locations. The St. Helena response was consistent with results from medium-risk locations elsewhere.

Figure 3 also shows the incidence of stayers actually observed in past evacuations around the nation. In high-risk areas, with effective dissemination of evacuation notices, no more than 5% usually refuse to leave. In moderate-risk locations, however, roughly 20% often refuse to leave. Residents from moderate-risk areas tend to overstate their likelihood of evacuating in hypothetical surveys.

Vacationers

Vacationers tend to leave from high-risk locations in about the same numbers as residents. They might be somewhat more likely than residents to leave from moderate-risk locations. The greatest uncertainties regarding vacationers concern other behaviors such as evacuation timing and evacuation destinations.

Conclusions

If officials take aggressive action and go door-to-door notifying residents to evacuate, the rates are most likely to be near 90% on the Charleston peninsula, 80% west of the Ashley, 85% in Beaufort, and over 90% on St. Helena. If door-to-door dissemination of evacuation notices is relied upon less and most of the dissemination is through the media, rates will be closer to 80% in east Charleston, 65% in west Charleston,

Figure 2

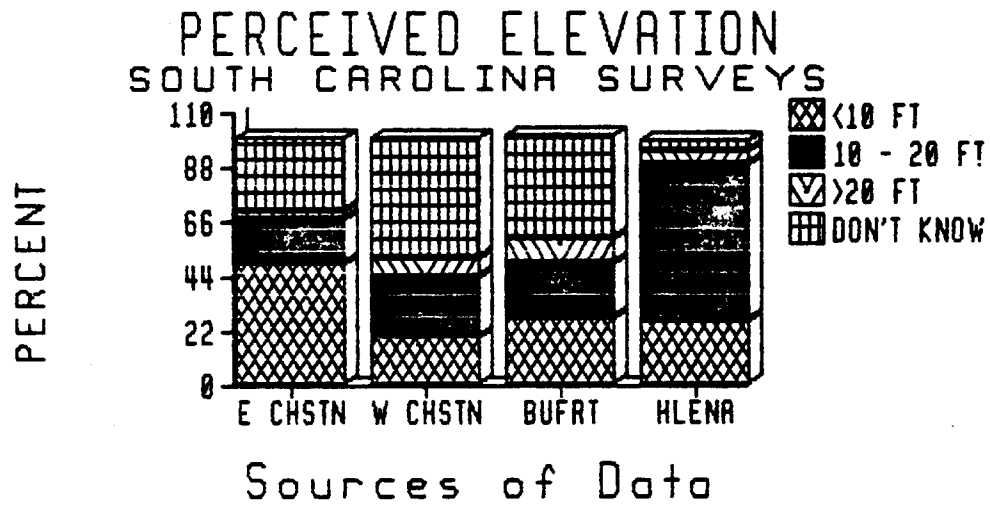
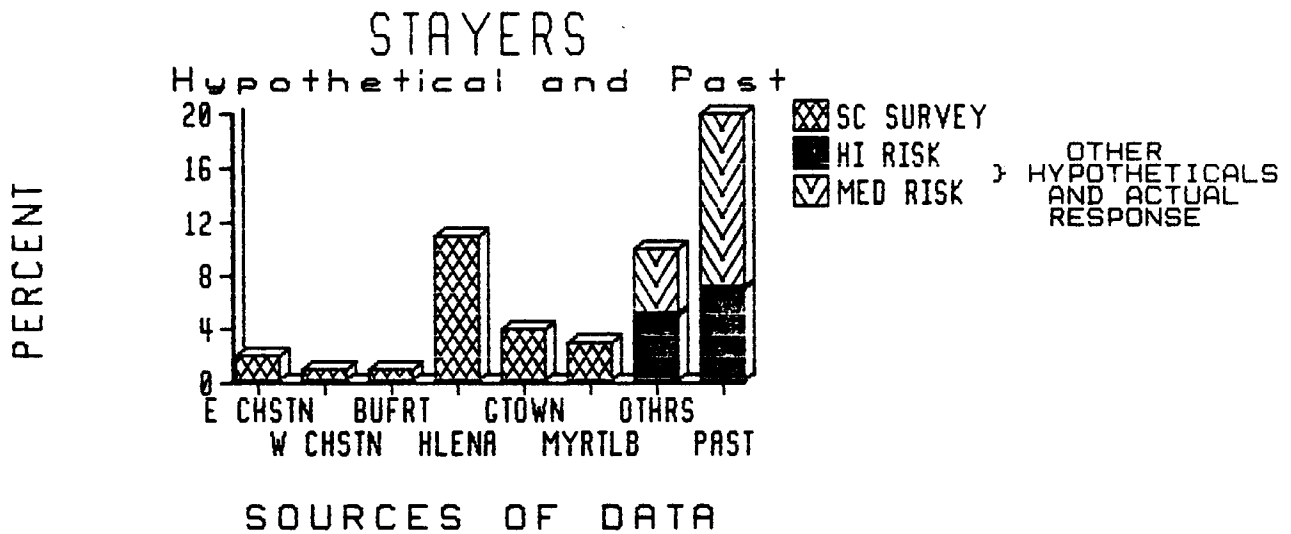


Figure 3



65% in Beaufort, and 80+% on St. Helena. It is also typical to see 20-40% of the population from low-risk areas bordering moderate and high-risk areas evacuate even if they are not advised. Unless they are advised to leave, no more than half of mobile home residents will evacuate from inland areas.

At least 90% of vacationers in high-risk locations will evacuate if notified. They will, however, rely to some degree upon the management of the establishment where they are staying for advice. Management, though, will affect evacuation timing more than evacuation rate. Perhaps half the scheduled new arrivals will cancel their reservations or delay their arrival if a hurricane is threatening the area.

EVACUATION TIMING

Residents

Figure 4 reveals the percentages of respondents who said they would leave during a watch, even if public officials had not advised evacuation at that time. In most areas roughly half the sample indicated that they would leave early, but on St. Helena 82% said they would leave before an evacuation notice. The 50% is typical of moderate-risk locations in other surveys; in high risk areas, however, 70-75% usually say they would leave early.

Experience shows that very few people actually leave before being advised by public officials. In most cases no more than about 15% of the population at risk leaves before evacuation notices are posted. The figure might be slightly higher in high-risk areas.

Once evacuation notices are issued, there is a great deal of variation in the promptness with which evacuees leave. One can plot graphically the cumulative percentage of evacuees who have left by a certain number of hours since being advised or ordered. Most such curves are "S" shaped, but variations depend upon the urgency of the evacuation, severity of the storm, and even time of day. Residents of high-risk locations will respond more promptly than other people. If time permits, most people will not leave at night; if the storm's arrival is imminent, however, people will leave at any time of day.

Vacationers

Vacationers' hyothetical responses suggest that most would leave early (during a watch without advice from public officials) if the weather is poor but not if the weather is good. Vacationers in the Myrtle Beach area in Diana left about the same time as residents. Otherwise there is very little experience upon which to draw.

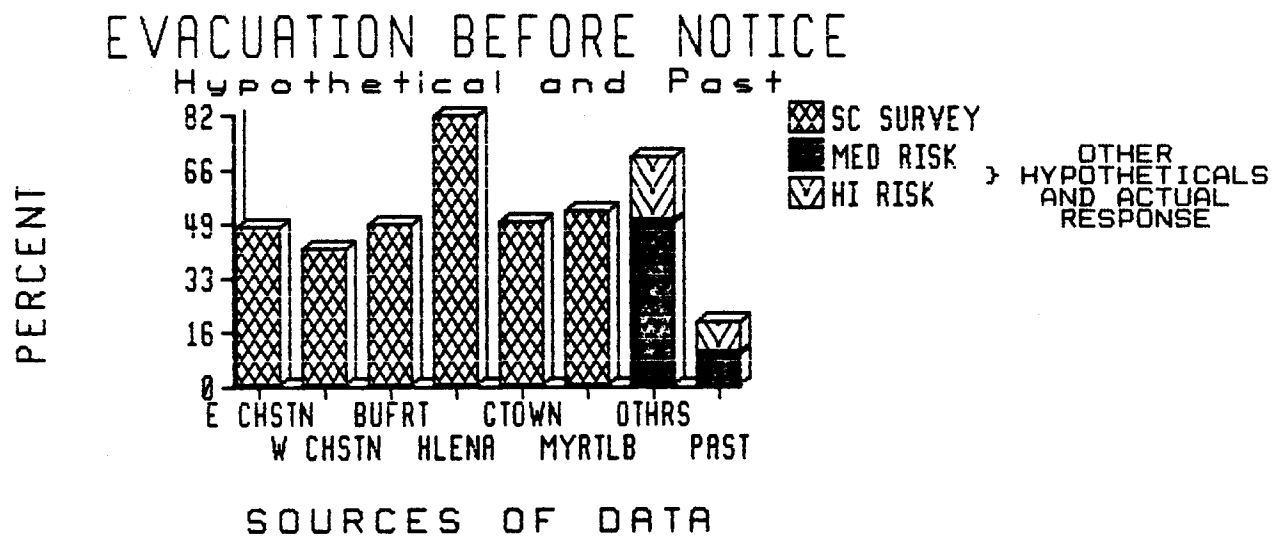
Many Hilton Head visitors plan to proceed to Florida after a 3 to 4 day stay. These plans would normally contribute to earlier evacuation (and simply arriving early in Florida rather than taking a chance on the storm at Hilton Head). Many hurricanes threatening South Carolina, however, will be threatening northeast Florida as well, and vacationers at Hilton Head might be reluctant to drive south on I-95 if it means heading toward the storm.

Conclusions

No one curve will always be applicable even to a single community, therefore, we recommend that three separate curves be used for planning purposes.

- a. An optimistic but realistic curve, assuming early, aggressive action by public officials: "S" shaped, with a notice issued about 14 hours or more before landfall, rapid response by the public, with 60-70% of evacuees leaving within the next 4 to 6 hours.

Figure 4



- b. A cautious but realistic curve, assuming marginally early, moderately aggressive action by public officials: Linear or "J" shaped, with notice issued 10 to 12 hours before landfall, fairly good public response, with 40-50% of evacuees leaving in the next 4 to 6 hours.
- c. A worst case curve, assuming late but aggressive action by officials: Sharply "J" shaped, with order given 6 to 8 hours before landfall, rapid response by the public with 50% of evacuees leaving during the next 2 to 4 hours.

Evacuees in high-risk areas will leave more promptly than others, and more of them will leave before officials advise or order evacuation. In most storms no more than 10% of moderate-risk residents and 20% of high-risk residents will leave before the notice. In the survey areas specifically, 10% might leave early in Charleston and Beaufort and 20% on St. Helena.

The same response curves should be used for vacationers and residents, although perhaps 25% of vacationers might leave before evacuation notices are issued. In some circumstances such as a severe storm already north of, say, Jacksonville and well offshore, as many as 50% of the vacationers might leave before being advised to, particularly if the weather is poor in South Carolina, even if the Carolina weather is not caused by the hurricane system.

TYPE OF REFUGE

Residents

There was significant variation among survey locations concerning the sort of refuge evacuees would seek in a hypothetical hurricane threat (Fig. 5). On the Charleston peninsula about 50% said they would go to public shelters, while only 25% of the sample west of the Ashley intended to go to shelters, and in Beaufort the figure was 35%. On St. Helena 62% of those intending to evacuate said they would go to public shelters.

A person's income, the hazardousness of his residence's location, and -- to a lesser extent -- his age affect whether he will go to a public shelter. The difference in response between the eastern and western areas of Charleston is mainly attributable to the fact that the peninsula has more low-income residents and more people over 65 years of age. The Beaufort results are typical for similar areas elsewhere.

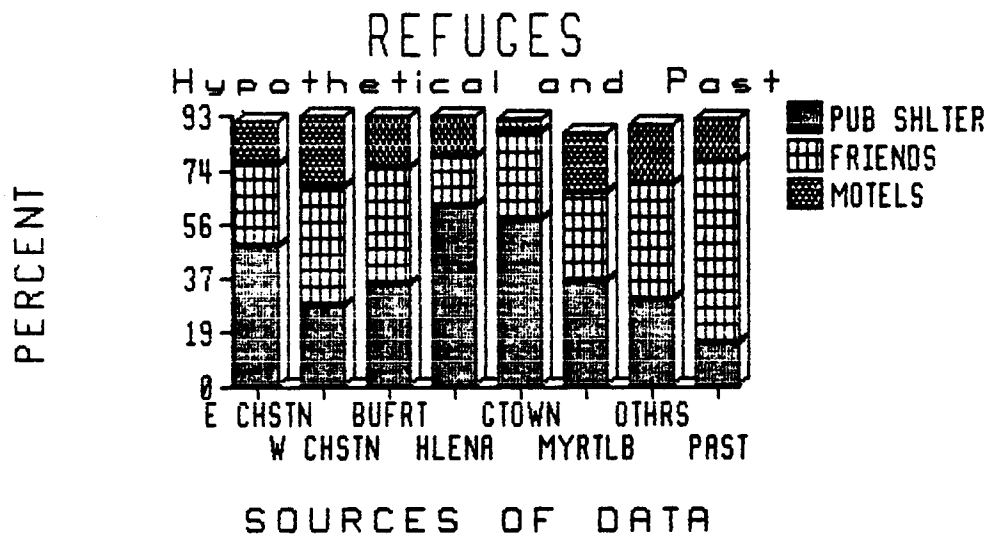
The 62% on St. Helena is higher than one usually finds, although it was only slightly higher than results from an earlier study in Georgetown. Island residents in most locations tend to evacuate further and go to the homes of friends and relatives. In this case, however, there is a significant low-income population and 33% of the sample was over 65 years old, both of which normally lead to greater reliance on public shelters. Based upon observations of people familiar with the area, there is apparently a close-knit black community on the island which does not have such close ties with mainland communities where residents might otherwise go to stay with friends and relatives. Most unusual in the survey on St. Helena was the fact that most respondents saying they would go to a public shelter actually named the specific shelter (St. Helena school).

In most instances people are far more likely to say they would go to public shelters than they truly are. Comparisons between hypothetical surveys before hurricanes and documentation after actual evacuations typically reveal that only half as many people end up going to shelters as thought they would. Options to stay with friends and relatives or even to go to motels become apparent during a hurricane threat which most people don't anticipate or assume. In most past evacuations, only 15% of the evacuees used public shelters. The highest documented was 31% in Camille in Mississippi in 1969.

Just over 100 people in the St. Helena sample said they were there when hurricane David threatened the area in 1979. The great majority said they didn't evacuate during David, and only two said they evacuated to a public shelter. Local officials, however, report that about 3,000 people went to St. Helena school during David, and at the time only 4,000 to 4,500 people lived on the island. The most likely explanation for the apparent discrepancy is that many residents "visited" the shelter for meals and socializing but didn't stay there. Officials in fact observed at the time that a certain amount of that kind of behavior occurred.

Motel use is affected by two factors more than others: income and the availability of motel rooms in safe locations. In the surveys 15% of east Charleston, 24% of west Charleston, 18% of Beaufort, and 14% of

Figure 5



of the St. Helena sample indicated that they would go to motels. Those figures are consistent with survey results in other parts of the country. Somewhat fewer people usually use motels than anticipate doing so, probably due a lack of availability and offers from friends and relatives.

Just as actions by public officials are the primary determinants of whether and when people evacuate, the kind of refuge which residents seek is also affected by official actions. Some communities actively discourage their constituents from using public shelters, even to the point of not publicizing the shelters' locations and by delaying their opening during a threat. Shelter use can also be diminished by actively encouraging people in safe locations to invite friends and relatives in more hazardous places to stay with them during a threat. When evacuation notices are issued the parties disseminating the notices can encourage residents not to rely upon public shelters. Conversely, reliance upon public shelters can be increased by taking the opposite actions.

Vacationers

When vacationers in North Carolina, South Carolina's Grand Strand, and northwest Florida were asked where they would go after evacuating their lodging, the great majority, 90%, indicated that they would return home. Interviews with motel operators in the Grand Strand area after Diana, however, suggests that there are certain circumstances in which most vacationers will either go to public shelters or go a short distance away to motels in safer locations.

These patterns are complicated in the Hilton Head area by the fact than many visitors plan to continue their vacation in Florida after a short stay in South Carolina and by the fact that some, perhaps 25%, of the visitors flew into the area by commercial air carriers for conventions. The average stay in the area is only 2.5 to 4 days. Such a brief planned visit is an inducement to leave the area entirely and not return later if a hurricane threatens. As we mentioned earlier, however, the location of many storms will pose a deterrent to people's plans to proceed to the south.

Visitors attending conventions pose a unique problem. Most will be inclined to leave the convention and return home, but it is unlikely that there will be sufficient flights or rental cars available to accommodate everyone. Convention organizers will depend upon hotel management for advice regarding cancellation, relocation, and so forth. Whatever plans the hotels have made for such contingencies will have the greatest bearing on where their convention guests seek refuge.

Conclusions

As we noted above, actions by officials can have a major influence upon the use of public shelters. Assuming that officials are not going to take unusual measures to either encourage or discourage the use of public shelters, the following figures are most probable. On the Charleston peninsula, where there are many low-income and elderly households, 30-35% will probably use shelters, while west of the Ashley a more typical 15% will do so. The same 15% figure is appropriate to most areas of Beaufort.

St. Helena poses an interesting case. Although 62% said they would go to public shelters, 43% of those respondents indicated that they have friends or relatives in safe locations where they could go. More than half of those said that, upon reconsideration, they might in fact stay with those friends or relatives after all. We would tend to reduce the 62% figure, but not by as much as we might normally suggest. In most cases 45% to 50% of St. Helena residents might evacuate to public shelters. Use rates higher than those would most likely stem from official actions which encourage greater shelter use. The income and racial differences among island residents will lead, however, to greater use of shelters by some parts of the population than others. The 45-50% figure is an average for the island.

Motel use by residents will probably be slightly less than the figures indicated by the survey data: east Charleston, 10%; west Charleston, 18%; Beaufort, 12%, and St. Helena, 10%.

In low threat situations, for example, a weak storm unlikely to strike the area, about 70% of the vacationers on the southern South Carolina coast will probably seek public shelters and motels, perhaps inland but near the coast. The breakdown between the two categories will depend upon the availability of motel rooms. In few cases will as many as 50% of the vacationers use public shelters. Those figures might also apply to more severe threats when the storm is "blocking" safe passage on I-95 to the south. In more severe threats when routes to the south are perceived as safe, 80% of the vacationers will return home or proceed with their vacation plans elsewhere. Visitors who flew into the area will attempt to fly out. Most of those who are unable to do so will take advantage of the options presented to them by the establishments hosting their functions.

LOCATION OF REFUGES

Residents

Figure 6 illustrates the tendency of evacuees to go out-of-town when they evacuate. In Charleston 50% of the sample said they would seek refuge out-of-town. Specifically 53% intended to go to Columbia, 14% to Summerville, 8% to Orangeburg, 6% to Greenville, and the remaining 19% were scattered among many places. In Beaufort 45% said they would go out-of-town. Again, Columbia was the leader with 34%, 21% were going to various Georgia destinations, 9% mentioned Aiken, and 36% would be widely dispersed. Thirty-five percent of the St. Helena sample indicated they would be going off the island, but 40% of those were to Beaufort and others were to nearby locations.

About 45% of the respondents in surveys in moderate risk locations usually say they would go out-of-town, while 50% from high-risk sites plan to leave the area. In actual practice only 40% of the moderate-risk population go out-of-town, but 60% of the high-risk evacuees leave.

Vacationers

Surveys with vacationers in other areas indicate that they would plan to return home if they evacuated, but the experience of the Grand Strand in Diana suggests that in low-threat situations many will evacuate to local or nearby refuges with hopes of returning if the storm misses. Grand Strand visitors tend to stay longer than Hilton Head visitors, however, and that could have an influence. The same experience suggests that when the threat is greater (as it appeared in the "second" Diana evacuation) vacationers do not return after evacuating, particularly if the evacuation occurs at the end of the week.

In specific reference to Hilton Head, the homes of most visitors are given by the following breakdown:

Georgia 15%
South Carolina 10%
Ohio 8%
Florida 7%
Pennsylvania 5%
New York 5%
North Carolina 4%
New Jersey 4%
Tennessee 4%
Illinois 3%
Other 34%

Those figures probably exclude fly-ins for conventions.

Conclusions

In most threats 35% of the east Charleston residents will go to out-of-town destinations, 45% from west Charleston, 40% from Beaufort,

Figure 6



and 35% from St. Helena, although most of the last group will be going only short distances. Breakdowns of specific city destinations will closely follow the distribution of places named in the surveys.

In extrapolating these results to other locations, recall that residents of high-risk locations evacuate further than those of moderate-risk locations, and that evacuees from low-risk areas go the shortest distances as a rule. The earlier people leave, the more likely they are to go out-of-town also.

Vacationers' and other visitors' destinations were discussed in the previous section dealing with type of refuge they would seek. Specific destinations of those returning home are best inferred from the state-of-origin breakdown given above. Recall too that most vacationers from north of South Carolina plan to eventually continue their vacation in Florida.

VEHICLE USE

Residents

The sources of transportation which the interviewees expect to use in an evacuation are shown in Figure 7. From a policy standpoint the most important revelation is that 12% of the east Charleston sample anticipates using some form of public transportation, and another 12% don't know how they will reach their destinations. Almost 20% of the St. Helena respondents anticipate riding with friends or relatives.

Corresponding to the above results, Figure 8 indicates the number of vehicles evacuees expect to take with them. East Charleston and St. Helena have the highest incidence of people not expecting to take any vehicles at all. St. Helena, however, also had the highest incidence of people planning to take two or more cars, possibly because of the greater perceived risk of leaving vehicles behind.

These figures indicate that residents plan to take about 65% of the available vehicles. These results are consistent with survey findings elsewhere and with actual experience. Not all vehicles are used in an evacuation due to the unwillingness to separate the family.

In east Charleston 2% of the respondents said they would be pulling a trailer when they evacuated, compared to 6% in west Charleston, 2% in Beaufort, and 6% on St. Helena. No one in the east Charleston or Beaufort samples said they would be taking a motorhome, but 3% in west Charleston and 5% on St. Helena said they would.

Vacationers

At least 75% of the visitors to Hilton Head drive and have their car available in an evacuation. The remaining visitors are primarily there with organized groups and would attempt to fly out or rent cars. Host establishments will probably provide transportation in many cases.

Conclusions

The survey results concerning vehicle use are consistent with actual practice as far as can be determined. To anticipate local variations in the numbers of vehicles of various types to be used, local vehicle registration records should be consulted.

Figure 7

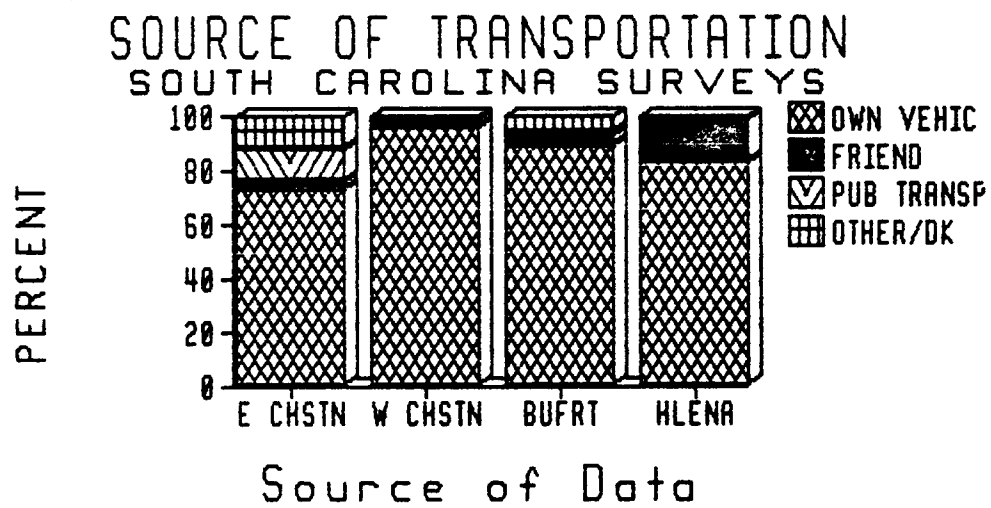
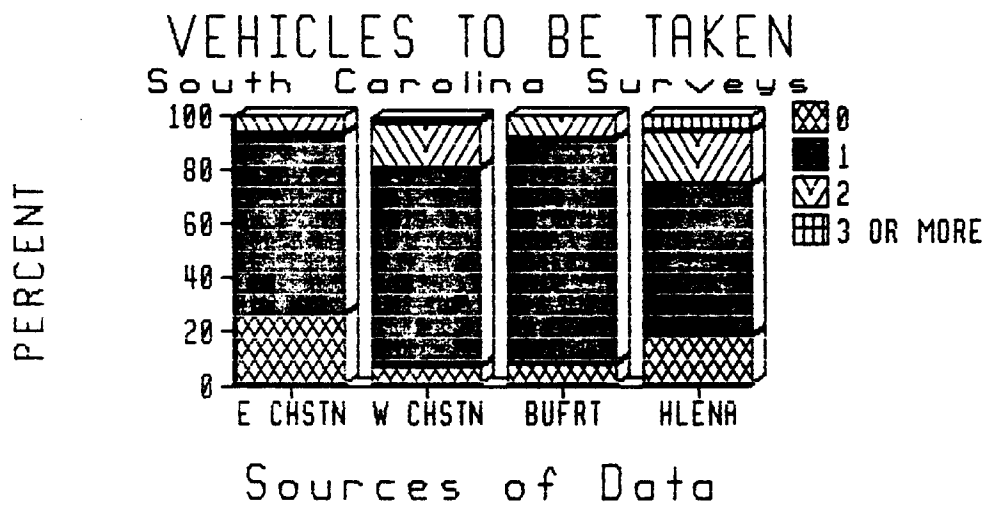


Figure 8



Appendix I
Resident Questionnaire

SOUTH CAROLINA RESIDENT QUESTIONNAIRE

Interviewer _____ Location _____

Date _____

Phone No. _____

Hello. I'm helping conduct a study that we hope will improve hurricane evacuation planning in (Charleston) / (Beaufort) County. We're interested in knowing where you would evacuate to, how you'd get there, under what conditions you would leave during a hurricane threat, and anything else you would like to have us tell emergency preparedness officials. Your identity will be confidential; just your answers will be reported.

1. First of all, do you live here year-round?

1 Yes (GO TO Q. 2)

(C.9)

3 No

IF NO:

Are you usually here during the summer?

1 Yes

(C.10)

3 No

2. Let's suppose there's a pretty bad hurricane out there in the Atlantic--say, a Category 3, a dangerous storm--and it looks like it could hit this area. The National Hurricane Center has issued a hurricane watch for this area--that means the storm probably won't hit for at least 24 hours, but low places in roads could be flooded sooner than that well before the worst of the hurricane arrived. Officials haven't advised any specific actions yet.

I know you can't say for sure what you would do in that situation, but do you think you and the rest of the people living with you would evacuate under those circumstances? When I say evacuate I mean going someplace else that you think would be safe if the hurricane hit; it could be nearby or far away.

10 Yes, all in household would leave or probably would

15 Some would leave then, others wouldn't

20 Don't know, maybe

(C.11-12)

25 No, wouldn't leave then

30 Other _____

IF RESPONDENT SAID YES TO 2, GO TO 3A; OTHERWISE GO TO 3:

3. Okay. Let's suppose the storm is a lot closer now. The Hurricane Center has issued a warning for this area, and officials have ordered an evacuation. For the sake of argument, let's suppose you and your household decided to evacuate.

- 3A. Where do you think you would go? First I want to know the type of place you'd go: a public shelter, a friend's or relative's, a motel, or someplace else.

IF PART OF HOUSEHOLD WOULD GO ONE PLACE AND PART ANOTHER PLACE,
RECORD 2 SETS OF ANSWERS

PARTY 1 () PARTY 2 ()

<u>10</u> Home	<u>10</u> Home	
<u>15</u> Public Shelter	<u>15</u> Public Shelter	
<u>20</u> Friend's/Relative's	<u>20</u> Friend's/Relative's	
<u>25</u> Motel	<u>25</u> Motel	(C.13-14)
		(C.15-16)
Other <u>30</u>	Other <u>30</u>	
<u>35</u> Wouldn't go at all	<u>35</u> Wouldn't go at all	

4. Where would that be--what city or town (if local, note neighborhood or suburb)?

(C.17-18)
(C.19-20)

5. What route would you take to get there?
(What main roads or streets, through what towns?)

(C.21
BLANK)

(C.22-23)
(C.24-25)

6. How many people would probably be in your group(s)?

(C.26-27)
(C.28-29)

7. What means of transportation do you think you would use?

<u>15</u> Take Own Vehicle	<u>15</u> Take Own Vehicle	
<u>20</u> Ride w/ Friend/Relative	<u>20</u> Ride w/ Friend/Rel.	(C.30-31)
<u>25</u> Expect Public Transit	<u>25</u> Expect Public Transit	(C.32-33)
<u>30</u> Don't Know	<u>30</u> Don't Know	
Other <u>35</u>	Other <u>35</u>	

8. How many cars or other vehicles do you have at your household?

_____ (C.32)

9. How many of them would you be taking when you evacuated?/
/Would you be taking it when you evacuated (If only one vehicle.)?

_____ (C.33)

10. Would you be pulling a trailer of any kind--boat, camper, etc.?

1 Yes

1 Yes

3 No

3 No

(C.34)

5 Don't Know

5 Don't Know

(C.35)

11. Would you be taking a motorhome?

1 Yes

1 Yes

(C.36)

3 No

3 No

(C.37)

IF "PUBLIC SHELTER" OR "MOTEL" IN Q. 3, GO TO 12; OTHERWISE GO TO 13.

12. A few minutes ago, you said you would probably go to a public shelter/
motel when you evacuated. Do you have friends or relatives either
locally or further away where you could go and feel safe if a hurricane
were threatening?

1 Yes

3 No (GO TO Q. 13)

(C.38)

5 Maybe/Depends

7 Other

IF YES OR MAYBE:

12a. Do you think you might go there rather than to a public shelter
or motel?

1 Yes

3 Maybe/Depends

(C.39)

5 No

(EXPLAIN)

(C.40
BLANK)

IF YES OR MAYBE

12b. Where do they live (town, city, or neighborhood)?

(C.41-42)

13. Have you ever been in this area before during a hurricane threat?

1 Yes

(C.43)

3 No

IF YES TO Q. 13, GO TO 14; IF NO, GO TO 16.

14. Which hurricane(s)?

(C.44-46
BLANK)

15. What did you do then?

HURRICANE 1

HURRICANE 2

HURRICANE 3

(Name)

(Name)

(Name)

10 Stayed

10 Stayed

10 Stayed

Evacuated to:

Evacuated to:

Evacuated to:

15 Public Shelter

15 Public Shelter

15 Public Shelter

20 Friend/Relative's

20 Friend/Relative's

20 Friend/Relative's

25 Motel

25 Motel

25 Motel

(C.47-48)

(C.49-50)

30 Other

30 Other

30 Other

(C.51-52)

1 Locally

1 Locally

1 Locally

(C.53)

(C.54)

3 Out-of-town to:

3 Out-of-town to:

3 Out-of-town to:

(C.55)

(Name)

(Name)

(Name)

(C.56-62
BLANK)

16. About how high above sea level is the ground your house is built on?

1 Less than 10 Feet

3 10 to 20 Feet

(C.63)

5 Over 20 Feet

7 Don't Know

17. So that we can figure out which evacuation zone you are in we need to know your street address. Like we said before, your response are completely confidential.

-
18. Which of the following categories best describes your household income for a year?

10 Less than \$10,000

15 \$10,000 to \$20,000

20 \$20,000 to \$30,000

(C.64-65)

25 \$30,000 to \$50,000

30 Over \$50,000

35 Refuse/Don't Know

19. Do you live in a mobile home?

1 No

(C.66)

3 Yes

20. How old were you on your last birthday?

1 Under 25

3 25 to 45

(C.67)

5 45 to 65

7 65 or over

9 Refuse

CLOSE

Thank you very much for your help. Do you have anything else you'd like to add that we haven't asked about?

Thanks again. Goodbye.

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